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July 17, 2018

VIA ELECTRONIC FILING (ECFS)

Marlene H. Dortch, Secretary
Federal Communications Commission
445 12th Street SW
Washington, DC 20554

Re: Ex Parte Notice: *TerreStar Corporation Request for Temporary Waiver of Substantial Service Requirements* – WT Docket No. 16-290

Dear Ms. Dortch,

Attached hereto is a presentation that describes TerreStar's initial technical study regarding 1.4 GHz Wireless Medical Telemetry Service ("WMTS") interference, which was completed in 2014, and was the subject of many discussions with FCC staff between 2014 and 2017. The study had three primary objectives: to define the impact of 1.4 GHz Smart Grid emissions to WMTS operation; to understand the technical basis for WMTS vulnerability and determine if hardware issues were the cause; and to determine whether WMTS vulnerability was due to regulatory non-compliance with FCC or FDA regulations. Based on the study, TerreStar confirmed the existence and severity of the WMTS interference problem and concluded that it was caused by insufficient receiver selectivity, not regulatory non-compliance. On at least eight occasions, these conclusions were presented to and never questioned by FCC staff or other parties during the pendency of the waiver.

As TerreStar has explained in this proceeding, beginning in early 2008, TerreStar began executing plans for the widespread deployment of a high-power network for use in smart-grid applications. In late 2013, FCC staff urged TerreStar to address potential interference concerns with users of WMTS in the immediately adjacent 1.4 GHz band. As part of these efforts, TerreStar reached out to incumbents in those spectrum bands to identify any potential technical issues related to its planned smart-grid deployments. TerreStar subsequently conducted extensive testing, as described in the attached presentation, and concluded that its planned smart grid deployment and WMTS were fundamentally incompatible, jeopardizing life critical patient monitoring networks at thousands of registered health care facilities across the country.

TerreStar confirmed in the 2014 study that passband filtration in the WMTS receiver extends well into the adjacent commercial allocation, causing even fully compliant fundamental commercial emissions in that allocation to interfere with and significantly desense the WMTS receiver. Many WMTS receivers employ Surface Acoustic Wave ("SAW") filters with very wide passbands of around 64 MHz to protect desired emissions from adjacent band interference. However, the SAW filters in commonly deployed 1.4 GHz WMTS equipment would apply no attenuation to TerreStar's proposed 1.4 GHz Smart Grid signal. For this reason, even relatively low incident power levels can cause intermittent failure of WMTS patient telemetry links. As a result, widespread deployment of WMTS networks makes the probability of patient harm from monitoring disruption extremely high.

The interference problem described above and discovered by the 2014 study is not the result of regulatory non-compliance. Compliance with the Part 95 rules does not require the demonstration of adjacent band rejection by WMTS receivers. Part 27 does not specify field strength limits for out of band emissions into the WMTS bands from fundamental emissions in the 1.4 GHz commercial spectrum. All currently certified 1.4 GHz Smart Grid and WMTS transceivers are fully compliant with Parts 27 and 95. Yet TerreStar's independent interference tests showed impairment and even complete WMTS failure depending on the interference power levels of the testing.

Based on the conclusions of the 2014 study, WMTS manufacturers and TerreStar informed FCC staff that simultaneous operation of TerreStar's smart grid and WMTS would cause destructive interference to WMTS systems. As a result of these tests, TerreStar began to actively pursue a commercial medical telemetry service with its 1.4 GHz band. For several years, the FCC staff remained constructively involved with TerreStar's plans and progress, through numerous phone calls and meetings. FCC staff never questioned or challenged these technical matters.

For these reasons, TerreStar was surprised when the Commission questioned the existence of an interference problem in denying TerreStar's waiver request. The decision stated that TerreStar "chose, for years, to pursue a business strategy that it ultimately came to believe—but has not demonstrated—could not be implemented without causing interference to adjacent spectrum users."[1] TerreStar never submitted the backup data on the 2014 interference analysis because FCC staff were fully aware of the study's conclusions and understood the interference problems that drove the parties' decisions. To fill any gap in the record, and out of an abundance

[1] *See TerreStar Corporation Request for Temporary Waiver of Substantial Service Requirements for 1.4 GHz Licenses*, Order, 32 FCC Rcd 7480, 7483 ¶ 8 (2017) ("TerreStar Order"). Had TerreStar known that FCC staff or other parties doubted the existence of the WMTS interference, it would have submitted the interference analysis along with its waiver request. But FCC staff were fully aware of—and had never questioned—the 2014 conclusions. Those conclusions were "presented" to them already. 47 C.F.R. § 1.106(c). In all events, the "public interest" would be ill served by ignoring the 2014 conclusions now, when FCC staff have known about them—and known that TerreStar and WMTS manufacturers have been relying on them—for years. *Id.* § 1.106(c)(2).

of caution, TerreStar hereby requests that the Commission accept this letter and the attached presentation for filing.[2]

Finally, TerreStar continues to respectfully seek reconsideration of the Order of the Chief of the Mobility Division of the Wireless Telecommunications Bureau,[3] which wrongfully denied TerreStar's Request for Temporary Waiver of Substantial Service Requirements. As the Commission has recognized in recent waiver grants, the purpose of the buildout rules is to "better promote access to spectrum and the provision of service"[4] and the Commission is obligated to treat TerreStar the same as similarly situated parties or to provide an explanation for disparate treatment.[5] Here, the Commission recently granted waivers in several analogous, and in some cases less compelling, circumstances.[6] Earlier this month, the Commission granted a waiver of the Section 27.14(g) rules for AT&T Mobility finding that strict application of the rules would be "contrary to the public interest."[7] Further, in AT&T, as is the case here, "enforcement of the buildout rules 'would merely delay broadband deployment at least in the

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[2] Although TerreStar has not previously submitted the backup data on the 2014 interference analysis in support of its waiver request, TerreStar has repeatedly submitted the conclusions of the analysis and thorough explanations of the interference problem that exists between commercial 1.4 GHz and WMTS operations. The Commission never requested the full analysis despite the filings in the proceeding. *See, e.g.*, Ex Parte by TerreStar Corporation, WT Docket No. 16-290, at 1 (filed Oct. 6, 2017); Ex Parte by TerreStar Corporation, WT Docket No. 16-290, at 3-5 (filed Sept. 20, 2017); Ex Parte of TerreStar Corporation, WT Docket No. 16-290, at 1 (filed Aug. 1, 2017); Ex Parte by TerreStar Corporation, WT Docket No. 16-290, at 2-5 (filed June 14, 2017); Ex Parte by TerreStar Corporation, WT Docket No. 16-290, at 3-4, Attach. A (filed June 12, 2017); Supplemental Comments of TerreStar Corporation, WT Docket No. 16-290, at 15-18 (filed June 7, 2017); Comments of TerreStar Corporation, GN Docket No. 16-46, at 5-6 (filed May 24, 2017); Reply Comments of TerreStar Corporation, WT Docket No. 16-290, at 2-3 (filed Oct. 14, 2016).

[3] *See generally* TerreStar Order.

[4] Letter from Roger S. Noel, FCC, to Karl Blake, Pole Communications Mutual Aid Corporation, *Request for Waiver and Extension of Time – 47 C.F.R. § 27.14(g) (Call Signs WQJS665 and WQJU904)*, DA 18-603, at 4 (June 13, 2018) ("June 2018 Polar Waiver Grant") (citing *Service Rules for the 698-746, 747-762 and 777-792 MHz Bands*, Second Report and Order, 22 FCC Rcd 15289, 15348 ¶ 153 (2007)).

[5] *Melody Music, Inc. v. FCC*, 345 F.2d 730 (D.C. Cir. 1965); *Petroleum Communications, Inc. v. FCC*, 22 F.3d 1164, 1172-73 (D.C. Cir. 1994).

[6] *See, e.g.*, *AT&T Mobility Spectrum LLC, BellSouth Mobile Data, Inc., New Cingular Wireless PCS, LLC, and SBC Telecom, Inc., Petition for Limited Waiver of Interim Performance Requirement for 2.3 GHz WCS C and D Block Licenses*, Order, 32 FCC Rcd 708 (WTB 2017); *American Samoa Telecommunications Authority Petition for Reconsideration, Request for Waiver, and Request for Extension of Time*, Letter, 32 FCC Rcd 6436 (WTB 2017); *The Alaska Wireless Network, LLC, Request for Waiver of Section 27.14(g)*, Letter, 32 FCC Rcd 4728 (WTB 2017). Indeed, the FCC continues to grant buildout extensions when the public interest requires it, as demonstrated by other recent waiver grants. *See, e.g.*, June 2018 Polar Waiver Grant (granting a waiver of Section 27.14(g) of the Commission's rules); Letter from Roger S. Noel, FCC, to Robert Vitanza, AT&T Services, Inc., *Request for Waiver of Section 27.14(g), WT Docket No. 18-67*, DA 18-601 (June 11, 2018) ("June 2018 AT&T Waiver Grant") (same).

[7] June 2018 AT&T Waiver Grant at 1.

near future'" and the "same challenges" will be present for future licensees.[8] As explained above, the WMTS interference threats described in the attached presentation do not stem from regulatory non-compliance, but an error in the Commission's rules. This same interference threat will exist for any future commercial 1.4 GHz licensees. Further, a denial of TerreStar's request, like AT&T's, would "have the very real impact of delaying … deployment."[9] Similar to other parties that have been given recent grants, TerreStar "diligently sought to deploy" and "believed in good faith" that it was working towards a solution that would allow it to meet its buildout requirements.[10] Its waiver request is one that is "limited in scope" but would generate great benefits for the public.[11]

Moreover, as TerreStar has explained, the Bureau's order erroneously conflated the distinct requirements for relief under Section 1.946(e)(1) and Section 1.925(b)(3).[12] "Unlike § 1.946(e)(1)'s standard for extensions," § 1.925(b) "does not require that" the circumstances justifying relief "be *outside the licensee's control*."[13] But in AT&T, the Bureau faulted one of the parties for conflating the requirements of those two sections in *exactly* the same way.[14] Similarly, the Bureau's order here erred in failing to address TerreStar's eligibility for relief under Section 1.925(b)(3)(i), which "provide[s a] separate and independently sufficient ground[] for granting a waiver" from Section 1.925(b)(3)(ii).[15] Again, the Bureau endorsed that precise point in granting relief in AT&T, explaining that "a waiver applicant need only satisfy *either* Section 1.925(b)(3)(i) or (ii)."[16] The Bureau must reconsider the TerreStar Order to correct these errors.

As explained above, grant of reconsideration, and providing TerreStar with additional time to meet its buildout requirements, would serve the public interest, further the purpose of the

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[8] *Id*. at 7.

[9] *Id*. at 8.

[10] *See* June 2018 Polar Waiver Grant at 5.

[11] *Id*. at 5.

[12] *See* Legal Analysis of the Wireless Telecommunications Bureau's Denial of TerreStar's Request for Temporary Waiver or Extension of Substantial-Service Requirements, at 8 (attached to Letter from Eugene Scalia, Counsel to TerreStar Corporation, to Marlene H. Dortch, Secretary, FCC, WT Docket No. 16-290 (filed Jan. 29, 2018)) ("TerreStar Legal Analysis").

[13] *Id.*

[14] June 2018 AT&T Waiver Grant at 4-5 ("RWA's argument conflates the standard for an extension under Section 1.946(e)(1), which expressly requires a showing that failure to meet the deadline is 'due to involuntary loss of site or other causes beyond the [licensee's] control,' with that for waiver under Section 1.925(b)(3)") (footnote omitted).

[15] TerreStar Legal Analysis at 14.

[16] June 2018 AT&T Waiver Grant at 4.

buildout rules, and result in faster deployment of the commercial 1.4 GHz spectrum.[17] For the above reasons, grant of reconsideration would be in the public interest and is consistent with Commission precedent.

Pursuant to Section 1.1206 of the Commission's rules, we are filing an electronic copy of this letter and the attached presentation in the above-captioned docket.

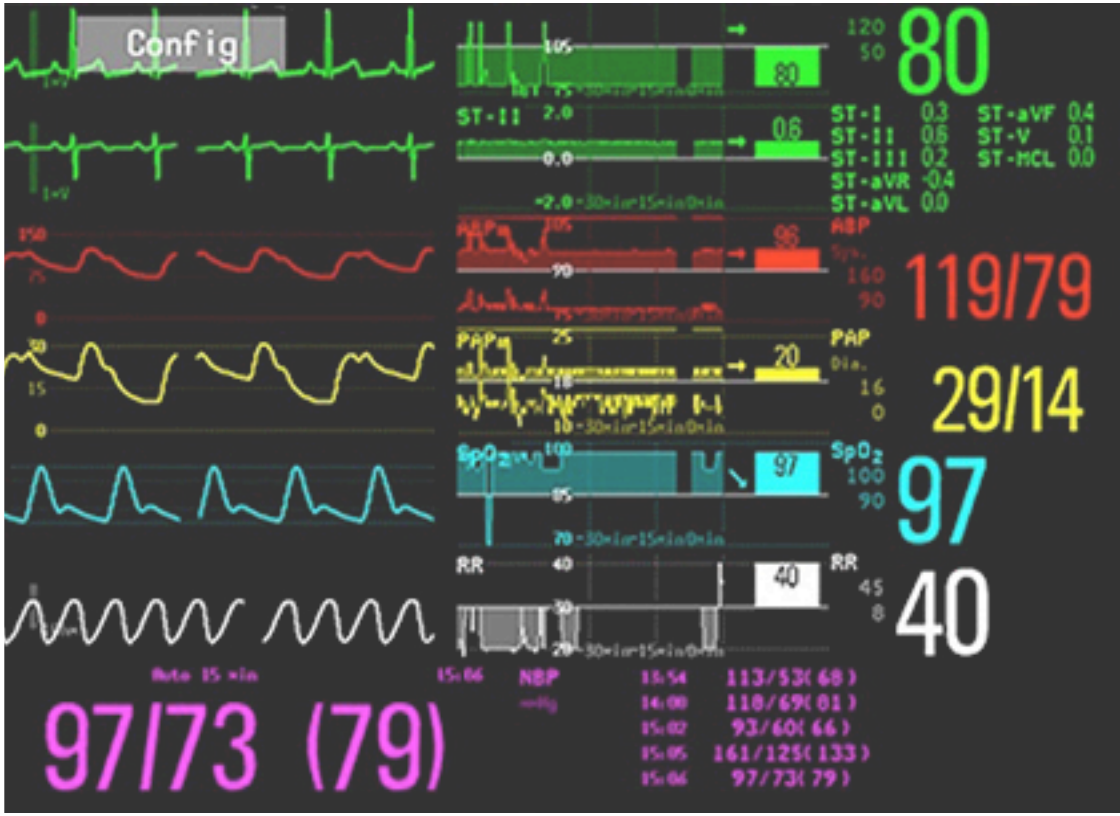
Sincerely,

/s/ Bryan N. Tramont

Enclosure

[17] Reconsideration of TerreStar's waiver request also is consistent with the focus of the Commission, Chairman Pai and Commissioner Carr in particular, on the positive impact the FCC's spectrum policy can have on improving access to telemedicine. *See, e.g.*, Newton N. Minow and Ajit Pai, *In rural America, digital divide slows a vital path for telemedicine*, Boston Globe (May 21, 2018), https://www.bostonglobe.com/opinion/2018/05/20/rural-america-digital-divide-slows-vital-path-for-telemedicine/t8n4ncsfFcUASdf7XLH38J/story.html; News Release, *Commissioner Carr Highlights FCC Focus on Telemedicine at UVA Health System* (July 2, 2018), https://docs.fcc.gov/public/attachments/DOC-352236A1.pdf.

TerreStar



1.4 GHz Commercial and WMTS Co-Existence

Summary of Medical Telemetry Interference and Failure Analysis

Introduction

The 1.4 GHz commercial band (collectively 1390-1395 MHz / 1432-1435 MHz) is governed by Part 27 rules and permits both fixed high power and mobile use. Following acquisition of all licenses in the 1.4 GHz commercial band by TerreStar in 2008, the Company developed the band for Smart Grid operations. From 2009 through 2013, TerreStar produced a diverse FCC-certified Smart Grid transceiver ecosystem, completed a special 802.16 standard for high reliability utility operations (WiGRID), and began trial leasing of its spectrum to electrical utilities.

In late 2013, FCC staff met with TerreStar and urged the Company to address potential interference concerns with users of the Wireless Medical Telemetry Service (WMTS) in immediately adjacent 1.4 GHz spectrum (collectively 1395-1400 MHz / 1427-1432 MHz). Following this, major medical device manufacturers informed TerreStar that its planned Smart Grid networks were potentially incompatible with WMTS, posing a serious risk to patient safety. Though TerreStar was fully compliant with Part 27 rules, WMTS interests warned that the Company's Smart Grid emissions would likely impair or even disable life-critical patient monitoring networks at thousands of hospital deployments across the United States.

TerreStar responded to the concerns of the FCC and WMTS community by immediately commissioning a technical study of the possible interference problems. This study had three objectives:

① **Define Impact of 1.4 GHz Smart Grid Emissions to WMTS Operation** – Evaluate the interference susceptibility of commonly deployed WMTS network receivers to emissions from Smart Grid transmitters certified for use in the commercial 1.4 GHz band.

② **Understand Technical Basis for WMTS Vulnerability to Smart Grid Emissions** – If commonly deployed WMTS network receivers show significant susceptibility to interference from commercial 1.4 GHz emissions, determine if hardware issues are the cause.

③ **Determine if WMTS Vulnerability is Due to Regulatory Non-Compliance** – If commonly deployed WMTS network receivers show significant susceptibility to interference from commercial 1.4 GHz emissions, determine if non-compliance with FCC or FDA regulations is the cause.

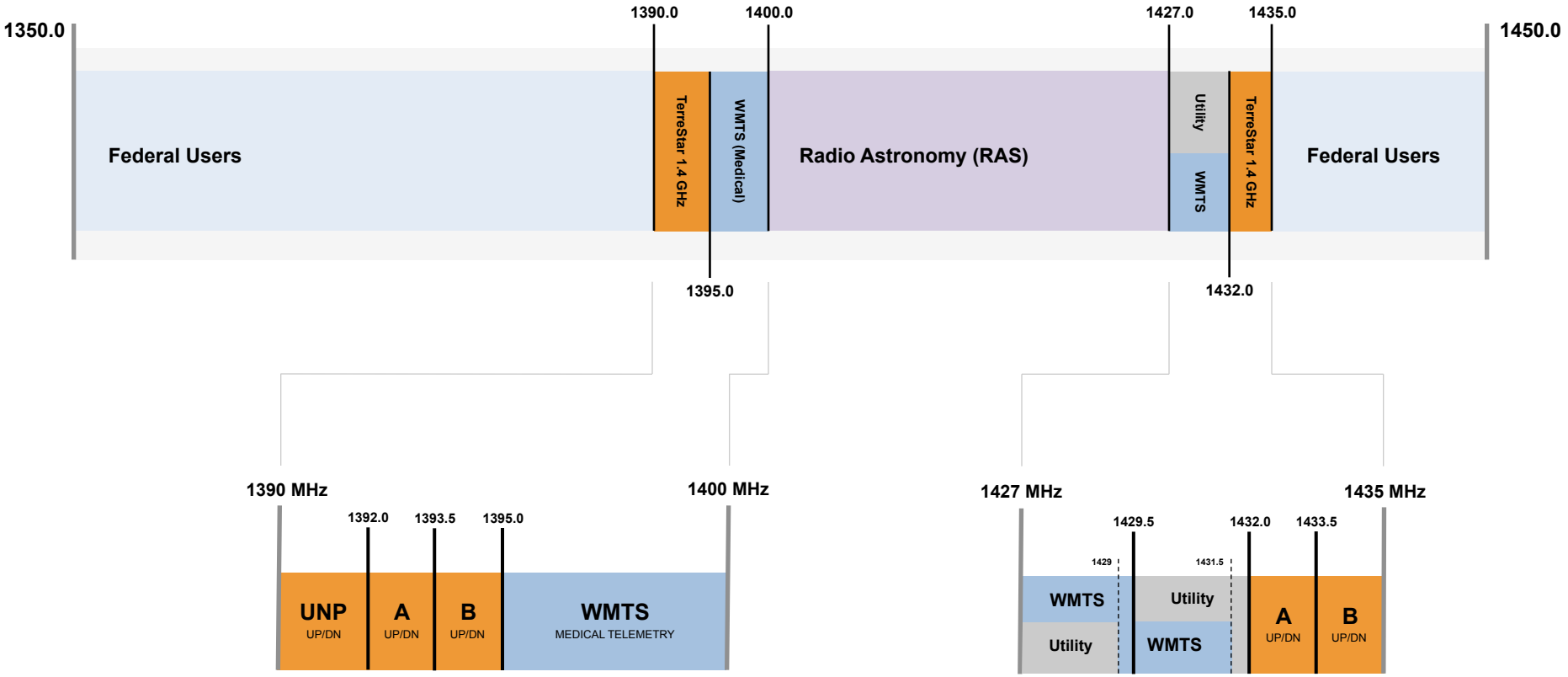
The following presentation is a brief summary of TerreStar's initial technical study regarding 1.4 GHz WMTS interference, which was completed in 2014. Based on the conclusions of this study, TerreStar was forced to suspend Smart Grid service deployment.

Contents

I: Incompatibility Between 1.4 GHz Commercial and WMTS Networks

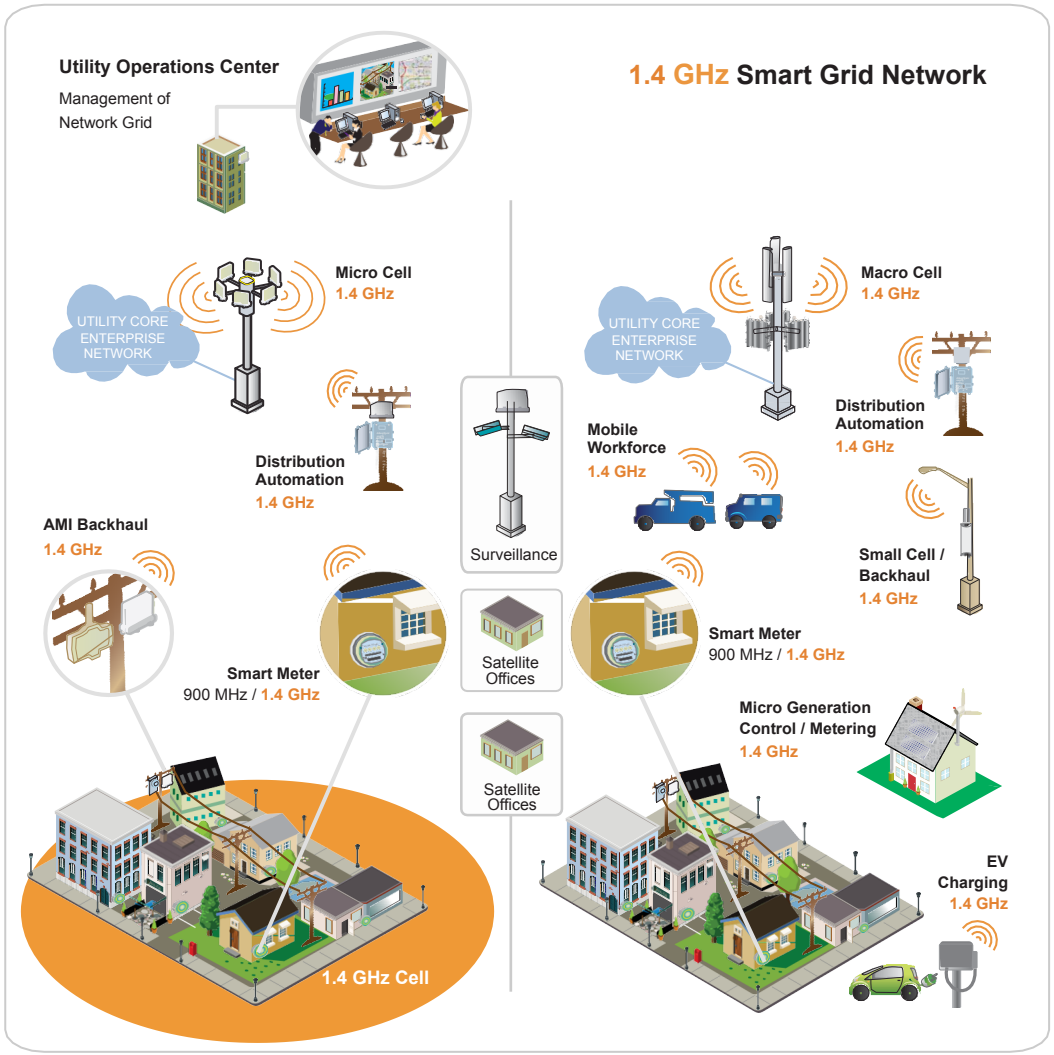
Immediately Adjacent 1.4 GHz Commercial and WMTS Allocations

The 1.4 GHz commercial and WMTS allocations sit directly adjacent to one another. Despite special emissions rules applied to the commercial band, the unforeseeable limited receiver selectivity of WMTS networks created a serious vulnerability in life-critical medical system operation.



Commercial Smart Grid Networks at 1.4 GHz

Smart Grid has become a central element in electrical utility modernization. TerreStar's 1.4 GHz spectrum was the only nationwide licensed broadband allocation suitable for Smart Grid service, and the Company had developed a full FCC-certified ecosystem for Smart Grid.



1.4 GHz Smart Grid Ecosystem

Base Station
Airspan MicroMAX

Mobile CPE
Airspan MRT

Portable Dongle
Airspan MiMAX

Indoor CPE
Airspan MiMAX Easy

Indoor / Outdoor Cell
Airspan MiMAX Pro

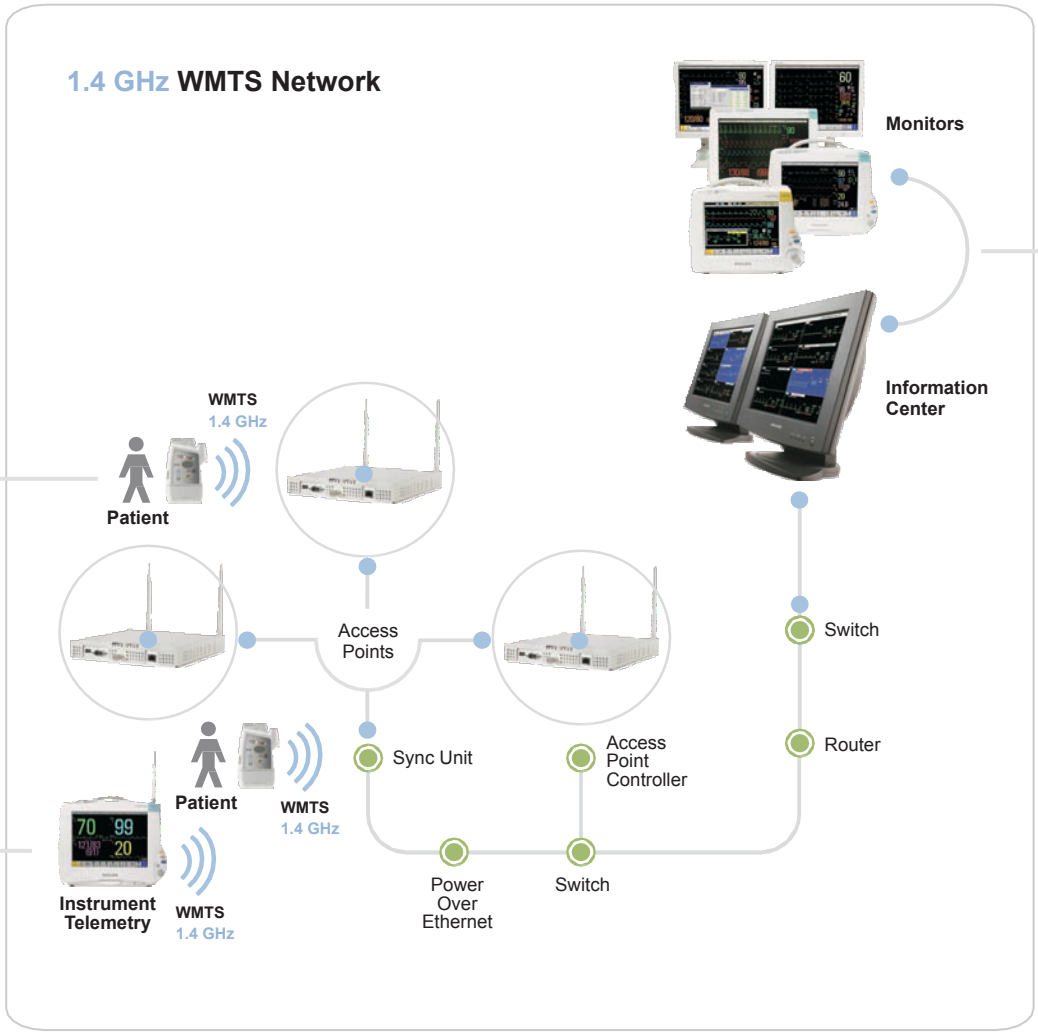
Base Station
Airspan Air4G

Base Station / Backhaul
Airspan AirSynergy

Base Stations / Nodes
Cisco Connected Grid

Wireless Medical Telemetry Service Networks at 1.4 GHz

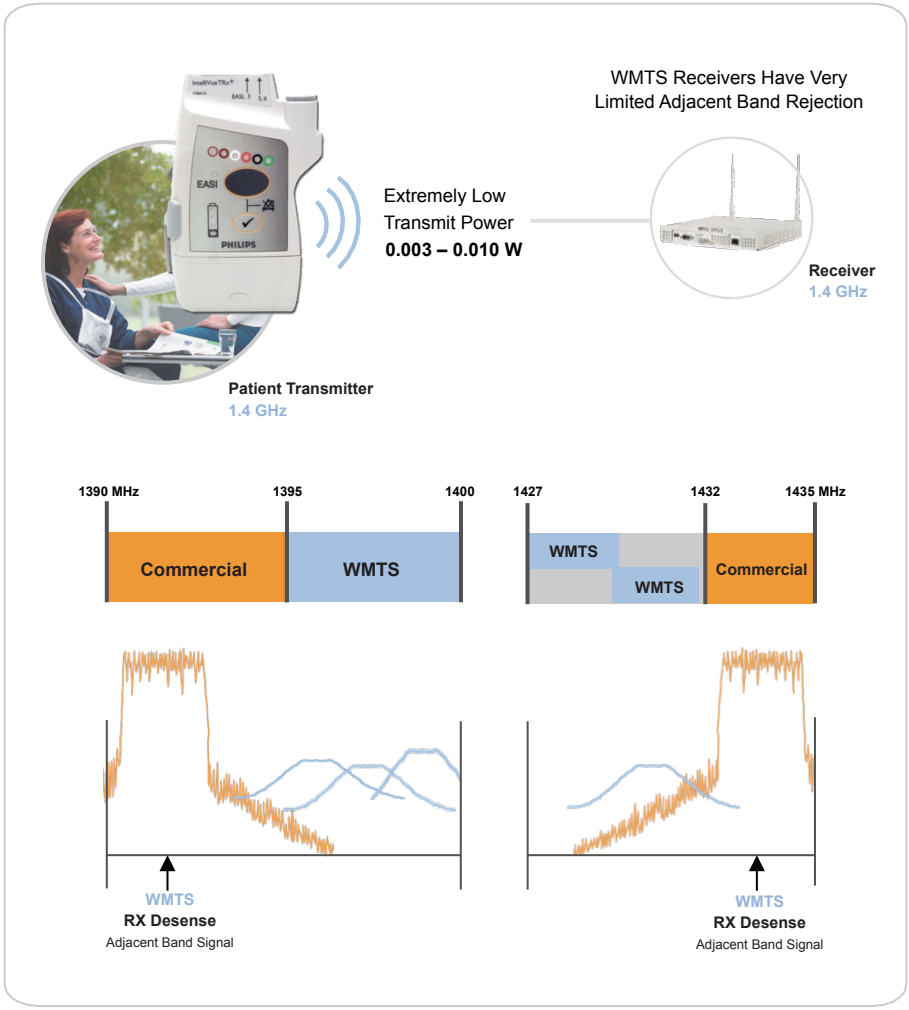
WMTS systems operating in the 1.4 GHz band provide life-critical services by enabling real-time monitoring for high-risk patients. Growing rapidly since the first deployment in 2010, WMTS now has approximately 8,500 deployments at major healthcare facilities across the US.



Real Time Patient Vitals Monitoring

Vulnerability of 1.4 GHz WMTS Networks to Smart Grid Network Interference

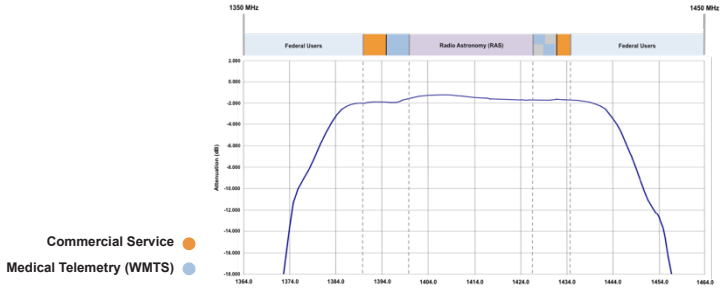
WMTS systems were designed with receivers that offer very little protection from adjacent band commercial emissions. This created an unforeseeable interference problem as TerreStar began deploying Smart Grid networks in the immediately adjacent commercial allocation.



II: Technical Roots of 1.4 GHz WMTS Network Vulnerability

Technical Roots of 1.4 GHz WMTS Network Vulnerability

Passband filtration in the WMTS receiver extends well into the adjacent commercial allocation, causing the fundamental emissions in that allocation to interfere with WMTS. Even fully rule compliant commercial operations thus represent a danger to patient safety.



- WMTS receiver passband extends into commercial spectrum.
- Fundamental commercial emission overloads WMTS receiver.

WMTS
1.4 GHz

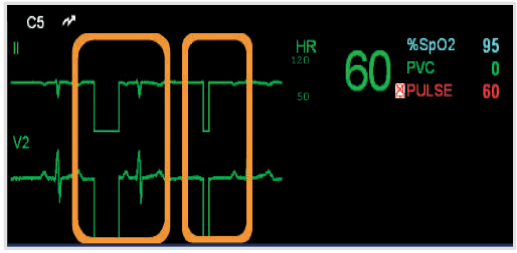
Patient

Receiver
1.4 GHz

Information Center

Base Station
1.4 GHz

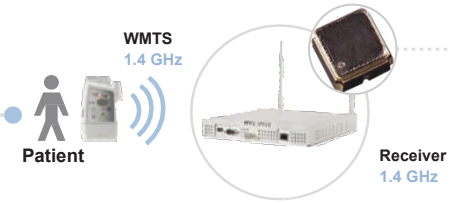
Terminal
1.4 GHz

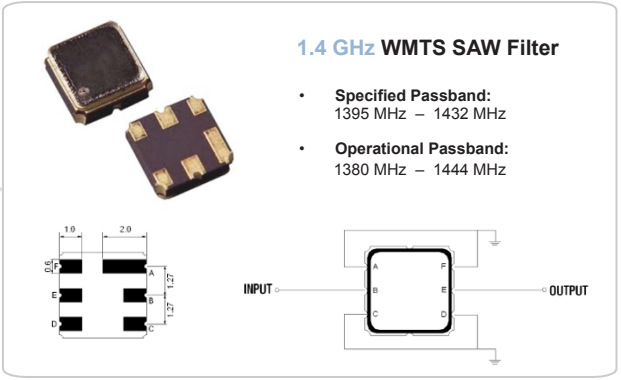


- Minimal interference results in patient data dropouts.
- Strong interference from adjacent band commercial service can disable patient monitoring.

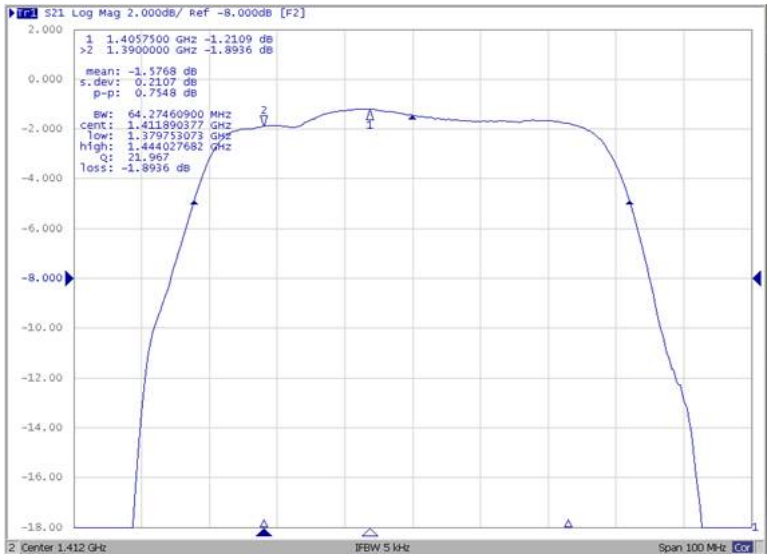
Wideband SAW Filter in Common Use by 1.4 GHz WMTS Receivers

WMTS receivers employ Surface Acoustic Wave (SAW) filters to protect desired emissions from adjacent band interference. SAW filters in commonly deployed 1.4 GHz WMTS equipment, however, are wide-banded and apply no attenuation to TerreStar's 1.4 GHz allocation.





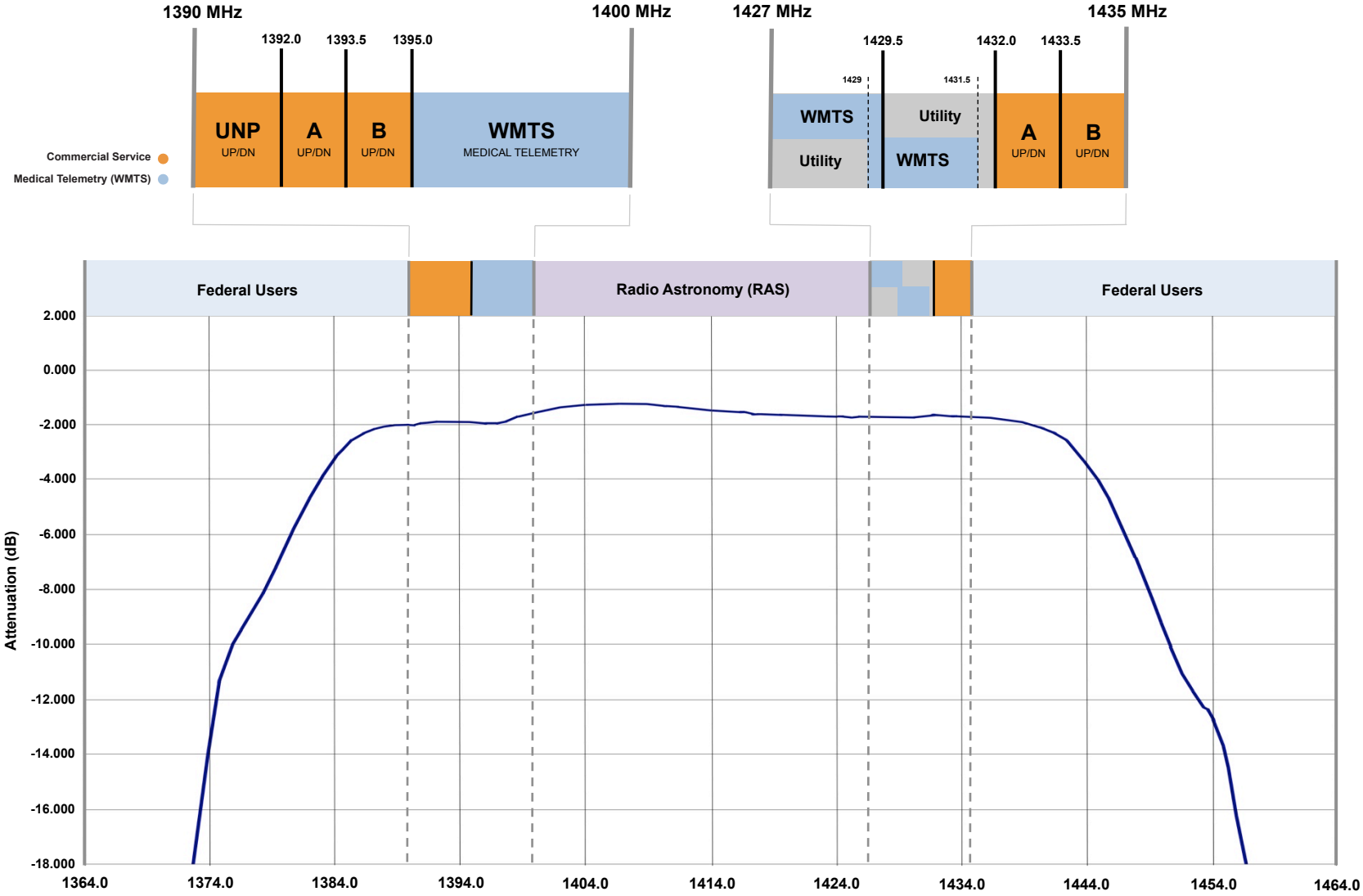
1.4 GHz **WMTS SAW Filter Passband** (CF: 1412 MHz / SPAN: 100 MHz)



1.4 GHz **WMTS SAW Filter Passband** (CF: 1412 MHz / SPAN: 300 MHz)

WMTS Receive Filter Passband Relative to 1.4 GHz Commercial Allocation

Passband filters in commonly deployed WMTS receivers exhibit insertion loss at TerreStar's 1.4 GHz frequencies comparable to that in the WMTS allocation they are designed to efficiently pass. This offers WMTS no protection from fundamental emissions in the TerreStar band.



III: FCC Rules Governing 1.4 GHz Commercial and WMTS Networks

FCC Emissions Rules for 1.4 GHz Commercial and WMTS Networks

Emissions rules for 1.4 GHz commercial and WMTS operations are governed by Parts 27 and 95, respectively. WMTS networks are limited to extremely low powers via a 740 mV/m at 3m field strength limit. There are no performance or certification requirements for WMTS receivers.

1.4 GHz Commercial Emissions Rules

Part 27.50: Power Limits and Duty Cycle

(e) The following power limits apply to the paired 1392-1395 MHz and 1432-1435 MHz bands as well as the unpaired 1390-1392 MHz band:

(1) Fixed stations transmitting in the 1390-1392 MHz and 1432-1435 MHz bands are limited to 2000 watts EIRP peak power. Fixed stations transmitting in the 1392-1395 MHz band are limited to 100 watts EIRP peak power.

(2) Mobile stations transmitting in the 1390-1392 MHz and 1432-1435 MHz bands are limited to 4 watts EIRP peak power. Mobile stations transmitting in the1392-1395 MHz band are limited to 1 watt EIRP peak power.

Part 27.53: Emission Limits

For operations in the unpaired 1390-1392 MHz band and the paired 1392-1395 MHz and 1432-1435 MHz bands, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) by at least 43 + 10 log (P) dB.

Part 27.804: Field Strength Limits at WMTS Facility

(a) For any operation in the 1392-1395 MHz band, the predicted or measured field strength – into the WMTS band at 1395-1400 MHz – shall not exceed 150 uV/m at the location of any registered WMTS healthcare facility. When performing measurements to determine compliance with this provision, measurement instrumentation employing an average detector and a resolution bandwidth of 1 MHz may be used, provided it accurately represents the true interference potential of the equipment.

NOTE: Part 27 does not specify field strength limits for out of band emissions into the WMTS bands from fundamental emissions in the 1390-1392 MHz and 1432-1435 MHz bands.

1.4 GHz WMTS Emissions Rules

Part 95.2369: WMTS Field Strength Limits

(b) For WMTS transmitter types operating in the 1395-1400 MHz and 1427-1432 MHz bands, the field strength of the transmitted signal must not exceed 740 mV/m, measured at 3 meters, using instrumentation with an averaging detector and a 1 MHz reference bandwidth.

Part 95.2385: WMTS RF Exposure Evaluation

Portable devices as defined in Part 2.1093(b) of this chapter operating in the WMTS are subject to radio frequency radiation exposure requirements as specified in Parts 1.1307(b) and 2.1093 of this chapter. Applications for equipment authorization of WMTS devices must contain a statement confirming compliance with these requirements. Technical information showing the basis for this statement must be submitted to the Commission upon request.

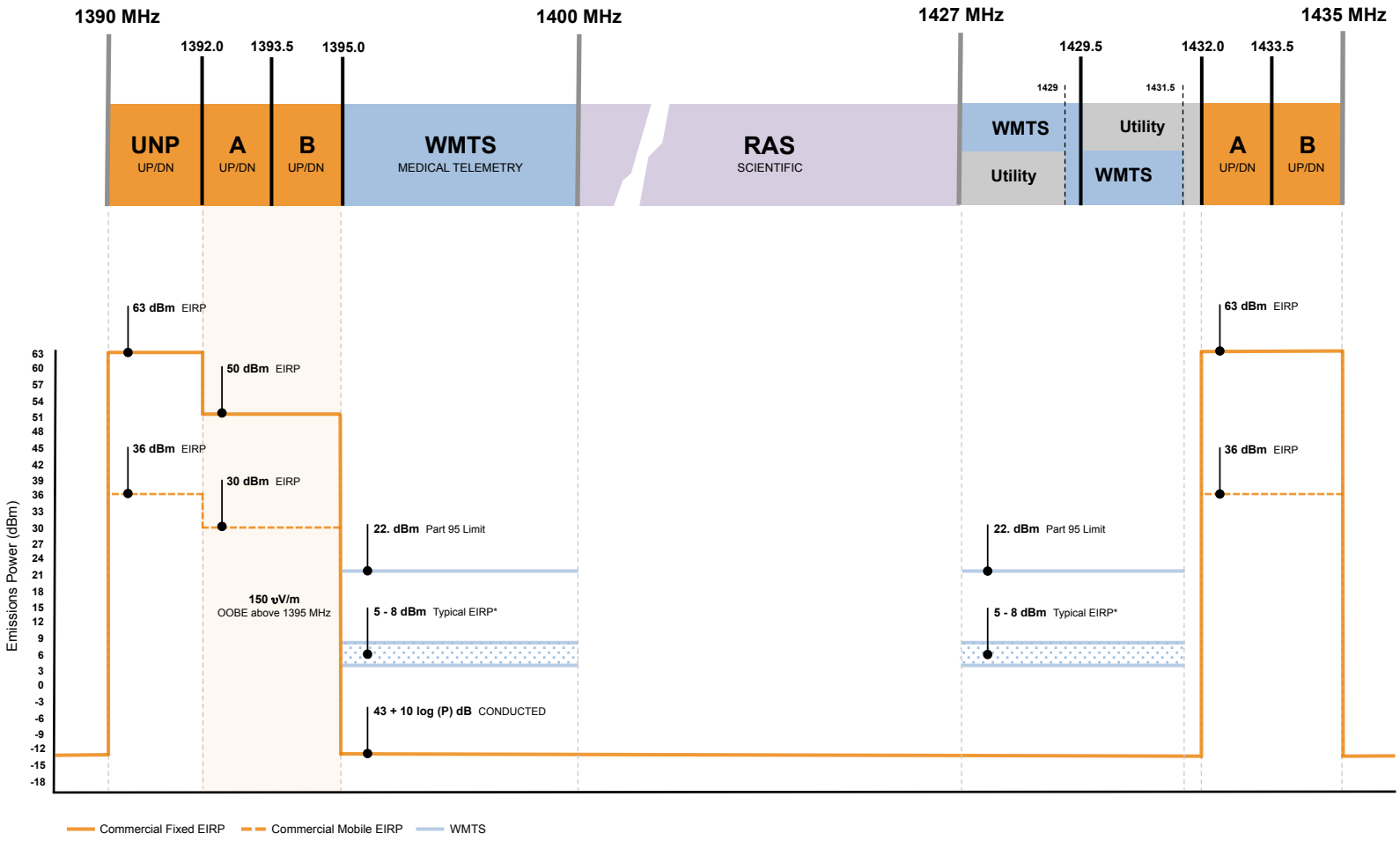
Part 95.2361: WMTS Transmitter Certification

(a) WMTS transmitters (transmitters that operate or are intended to operate in the WMTS) must be certified in accordance with this subpart and the provisions of part 2, subpart J of this chapter.

NOTE: Part 95 does not require certification or any other form of demonstration or reporting of WMTS receiver performance.

Graphical Summary of FCC Emissions Rules for 1.4 GHz Commercial and WMTS Networks

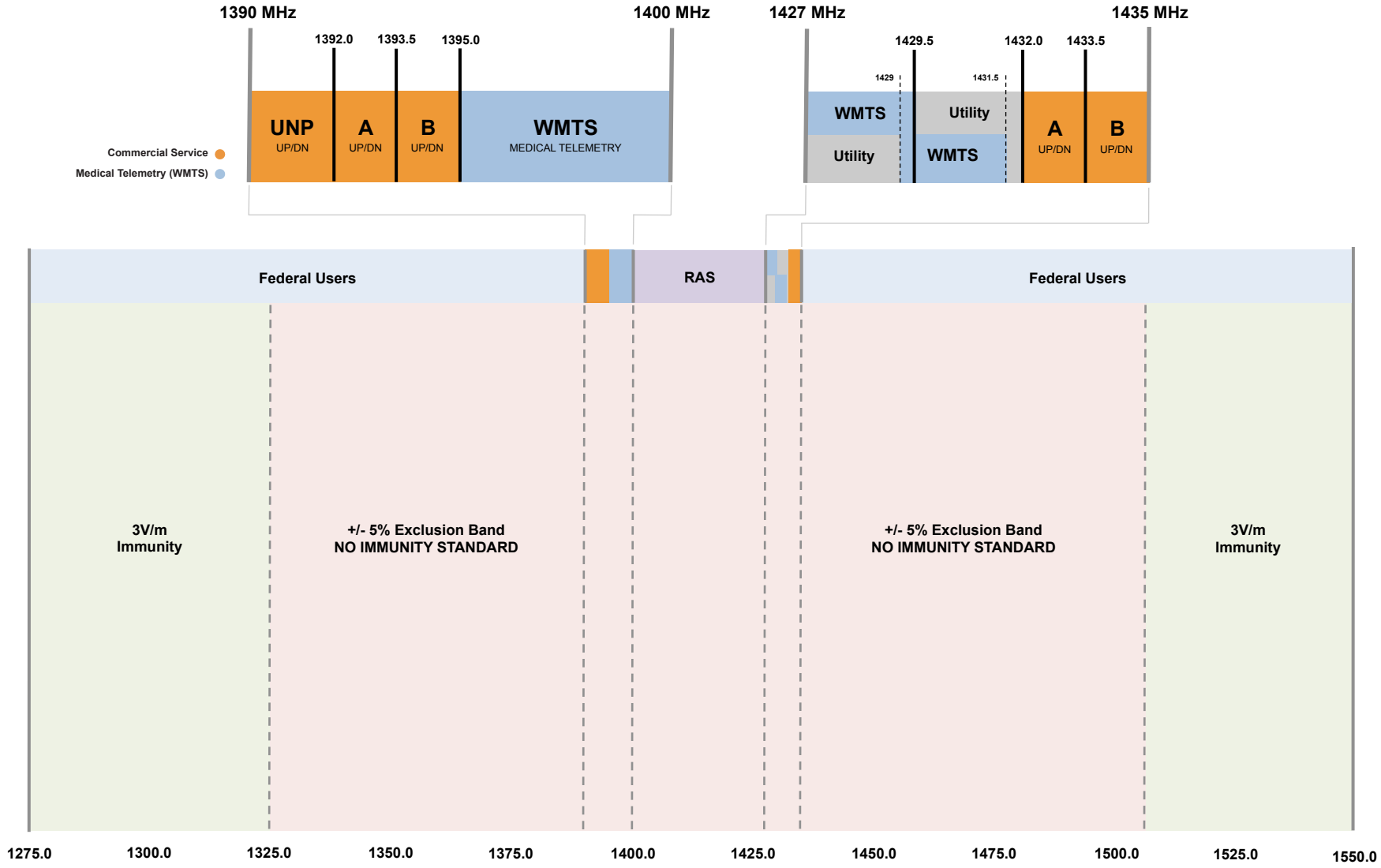
Commercial 1.4 GHz services may emit up to 63 dBm EIRP (36 dBm EIRP for mobile). Lower A+B block power is limited to 50 dBm EIRP (30 dBm EIRP for mobile) with a 150 uV/m OOBE field strength inside registered hospitals. These limits offer no practical protection to WMTS.



*Battery life and SAR compliance typically limit WMTS transmitters to < 8 dBm EIRP.

IEC 60601-1-2 Medical Device Interference Immunity Standard

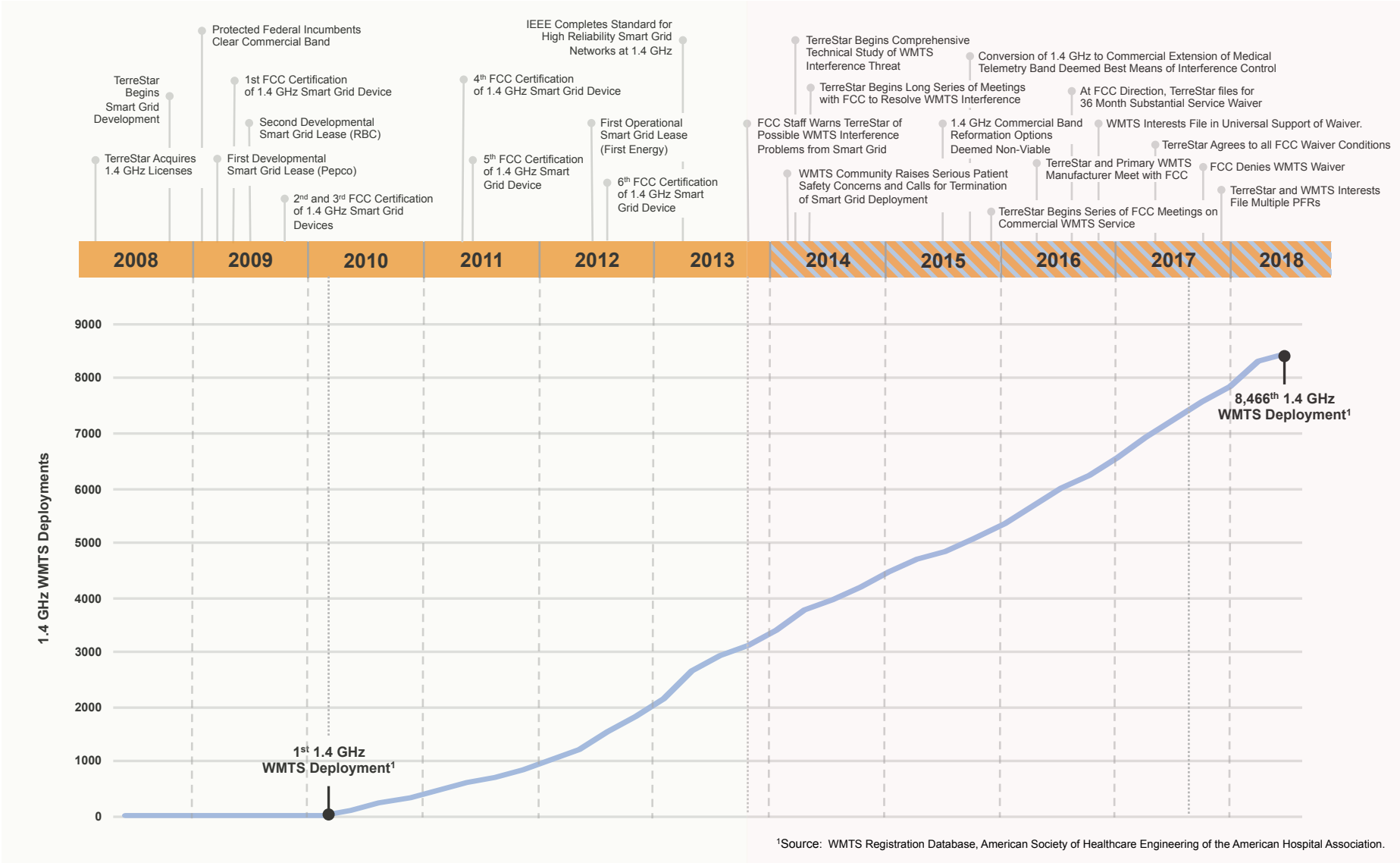
FDA assessment of medical devices relies upon compliance with IEC 60601-1-2 standards for RF interference immunity across 80-2000 MHz. While 1.4 GHz WMTS hardware is IEC compliant, the permitted “exclusion band” requires no interference immunity from commercial 1.4 GHz.



IV: Development Timeline of 1.4 GHz Commercial and WMTS Networks

Coincident Timeline of Commercial and WMTS Networks

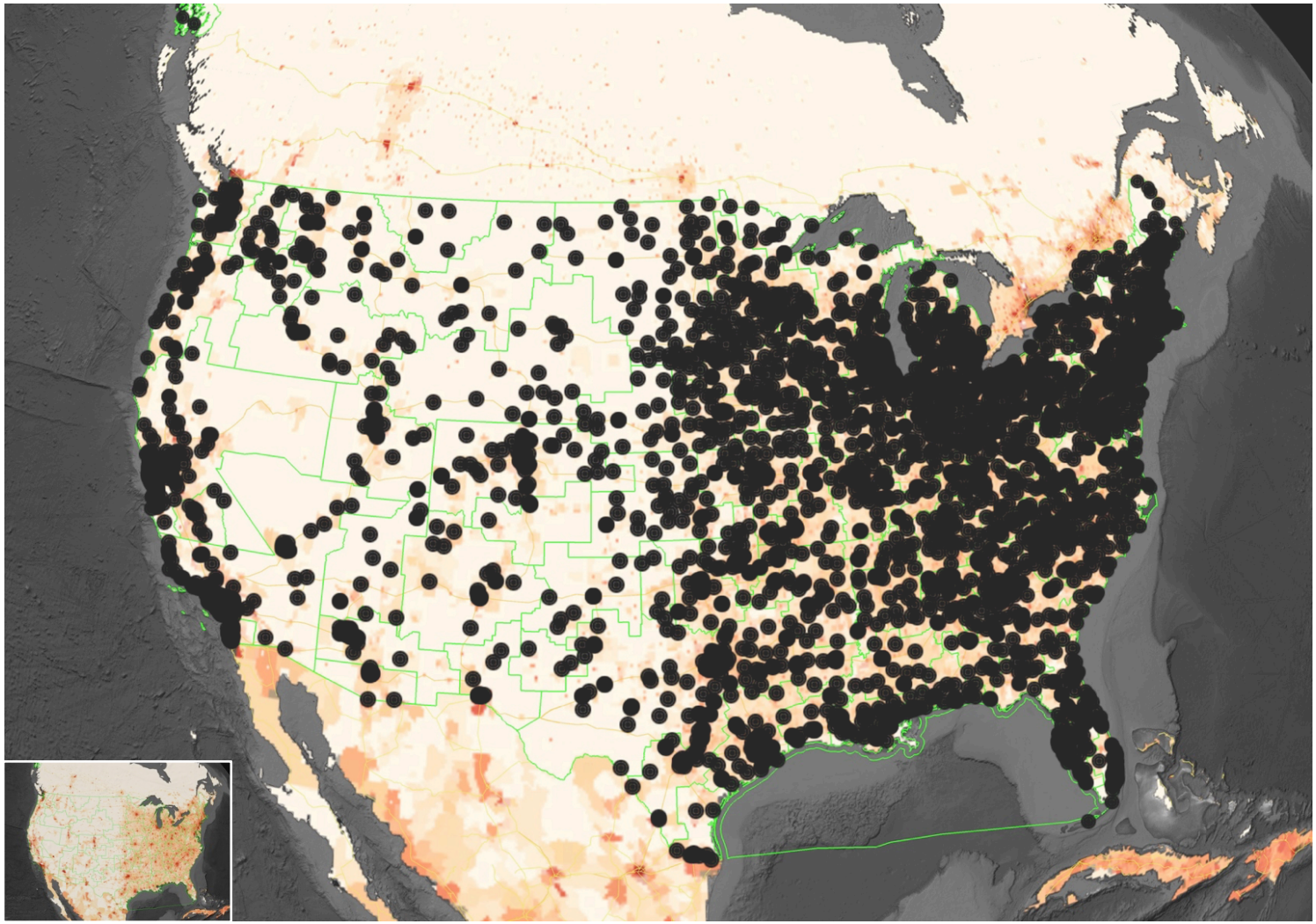
When TerreStar acquired its licenses and began certifying devices for the 1.4 GHz commercial band, no WMTS deployments had yet occurred. Neither service could have foreseen the interference problems that would result from the rapid growth of WMTS after 2010.



[1]Source: WMTS Registration Database, American Society of Healthcare Engineering of the American Hospital Association.

Geographic Distribution of 1.4 GHz WMTS Network Deployments

As of May 2018, 8,466 1.4 GHz WMTS network deployments were operational across the United States. According to ASHE, 1.4 GHz WMTS network deployments are growing at a rate of approximately 20% per annum. They exist in every significant domestic population zone.



1.4 GHz WMTS Deployments

Deployment Count: 8,466 Networks

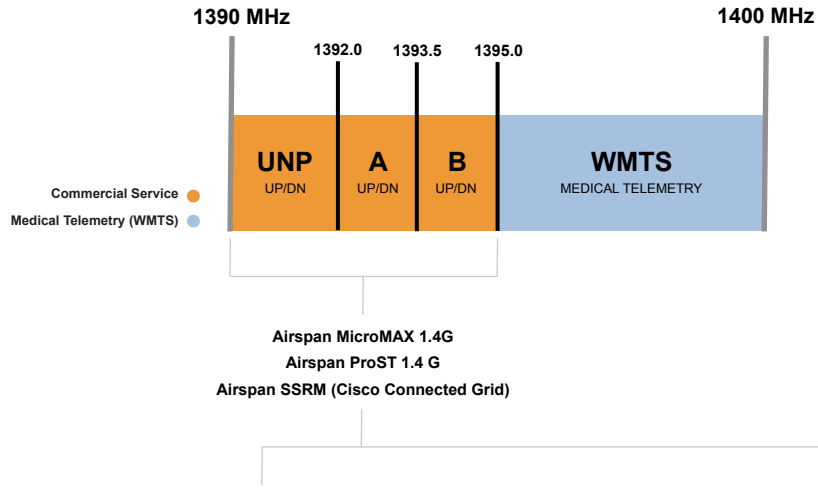
Date of Last Update: May 2018

NOTE: Map points represent multiple 1.4 GHz WMTS network deployments.

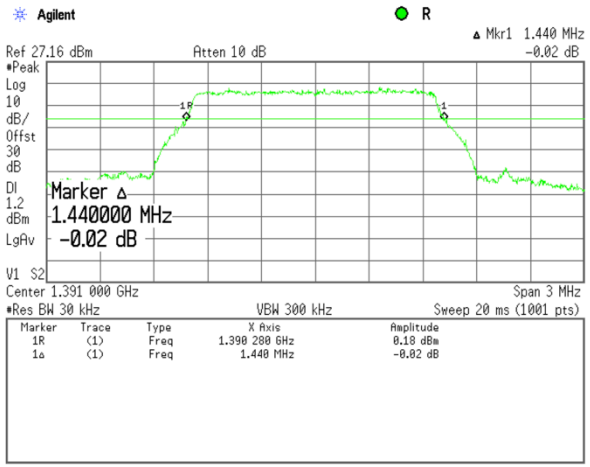
V: 1.4 GHz Commercial to WMTS Interference Analysis

Typical Emissions of FCC Certified 1.4 GHz Commercial Devices – Lower Band

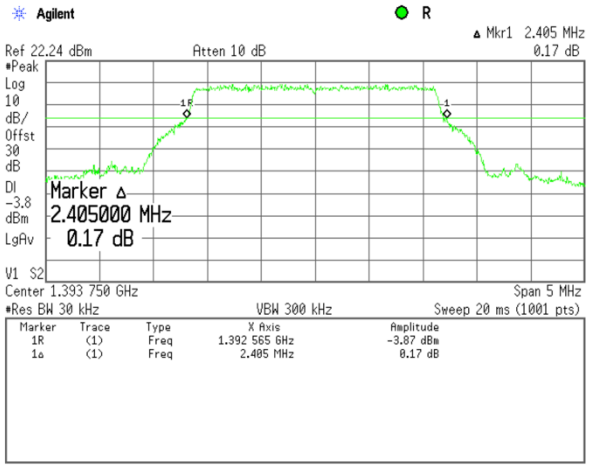
TerreStar and its partners created a full Smart Grid ecosystem for the 1.4 GHz commercial band. The FCC certified devices for the lower 1.4 GHz band between 2009 and 2012. Certified transceivers produce 802.16 emissions in 1.5 MHz, 3 MHz and 5 MHz channel widths.



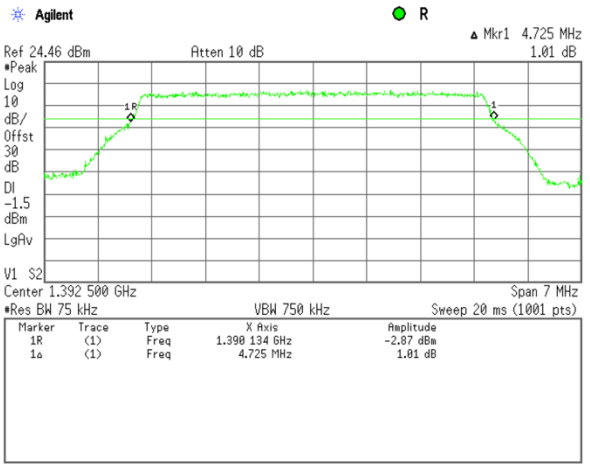
1.5 MHz Channel – UNP Block



3 MHz Channel – Lower A/B Blocks

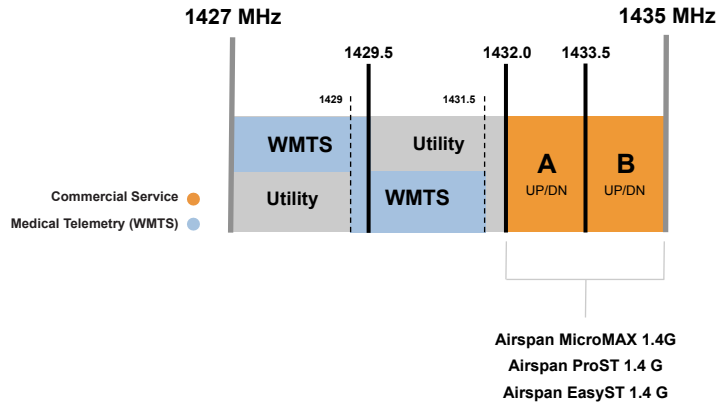


5 MHz Channel – UNP + Lower A/B Blocks



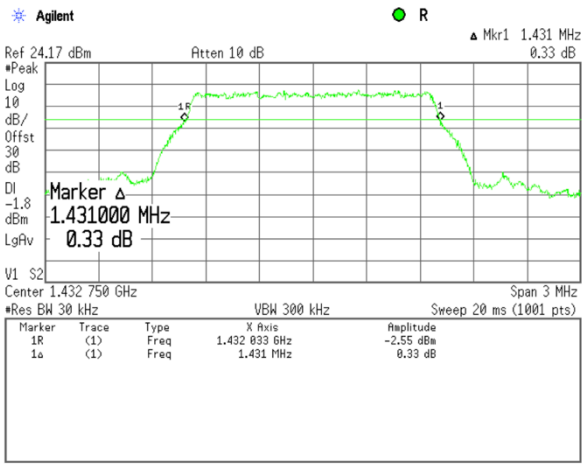
Typical Emissions of FCC Certified 1.4 GHz Commercial Devices – Upper Band

The FCC certified devices for the upper 1.4 GHz band between 2009 and 2012. Certified transceivers produce 802.16 emissions in 1.5 MHz, 3 MHz and 5 MHz (lower band) channel widths.

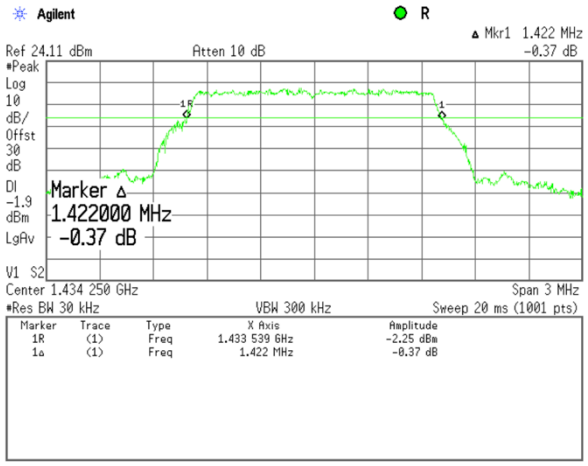


Airspan MicroMAX 1.4G
Airspan ProST 1.4 G
Airspan EasyST 1.4 G

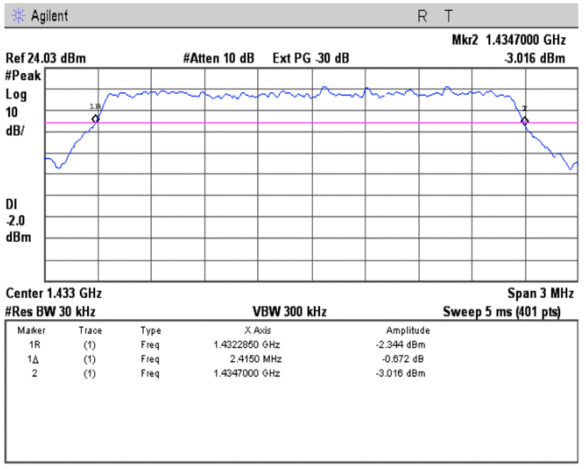
1.5 MHz Channel – Upper A Block



1.5 MHz Channel – Upper B Block

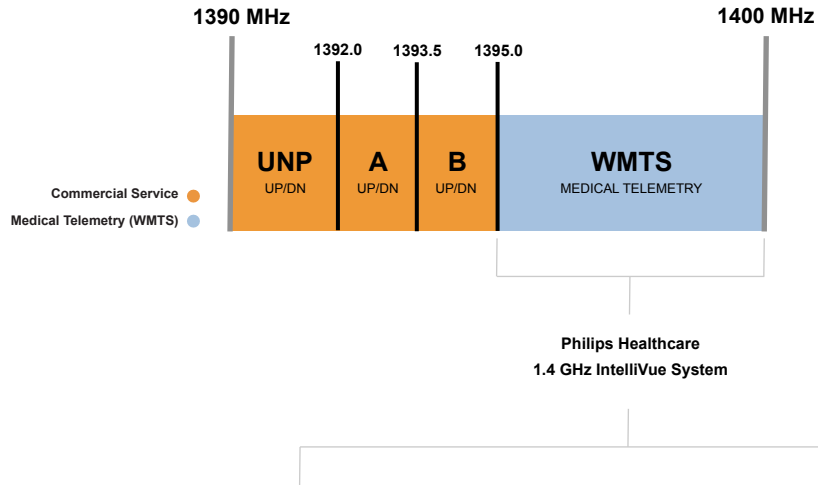


3 MHz Channel – Upper A/B Blocks

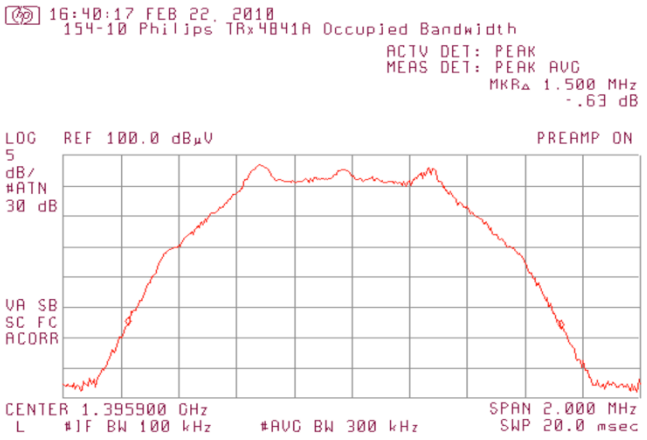


Typical Emissions of FCC Certified 1.4 GHz WMTS Devices – Lower Band

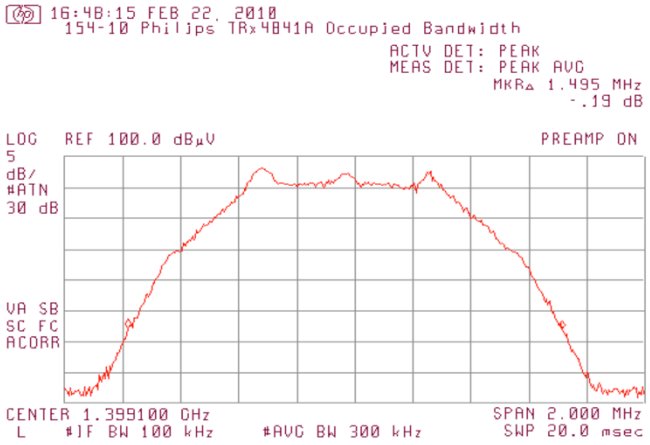
Several medical device manufacturers have received FCC certification for WMTS transceivers. Philips Healthcare produced devices represent the overwhelming bulk of WMTS deployments. These devices produce DECT emissions in 1.6 MHz channels (three lower band channels).



1.6 MHz Channel – Channel 1

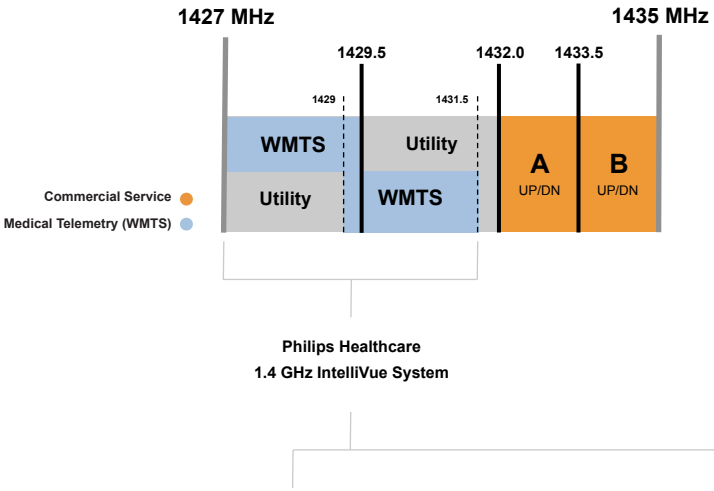


1.6 MHz Channel – Channel 3

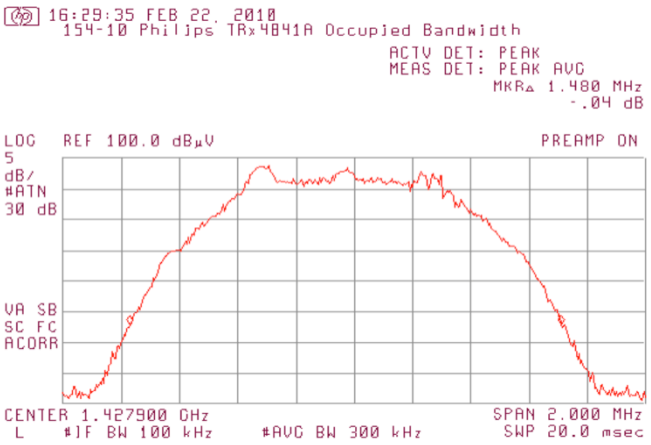


Typical Emissions of FCC Certified 1.4 GHz WMTS Devices – Upper Band

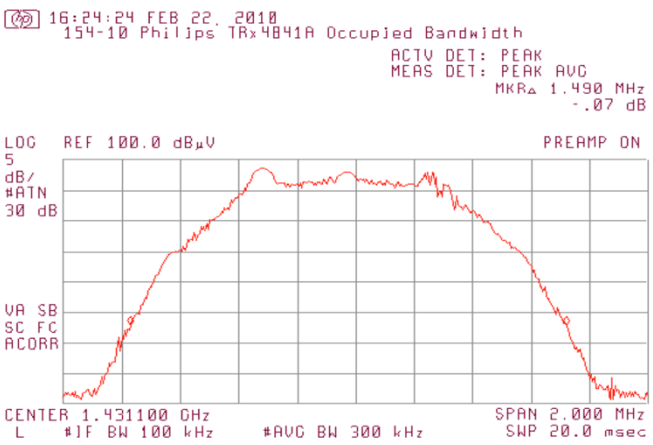
Several medical device manufacturers have received FCC certification for WMTS transceivers. Philips Healthcare produced devices represent the overwhelming bulk of WMTS deployments. These devices produce DECT emissions in 1.6 MHz channels (one upper band channel).



1.6 MHz Channel – Channel 4

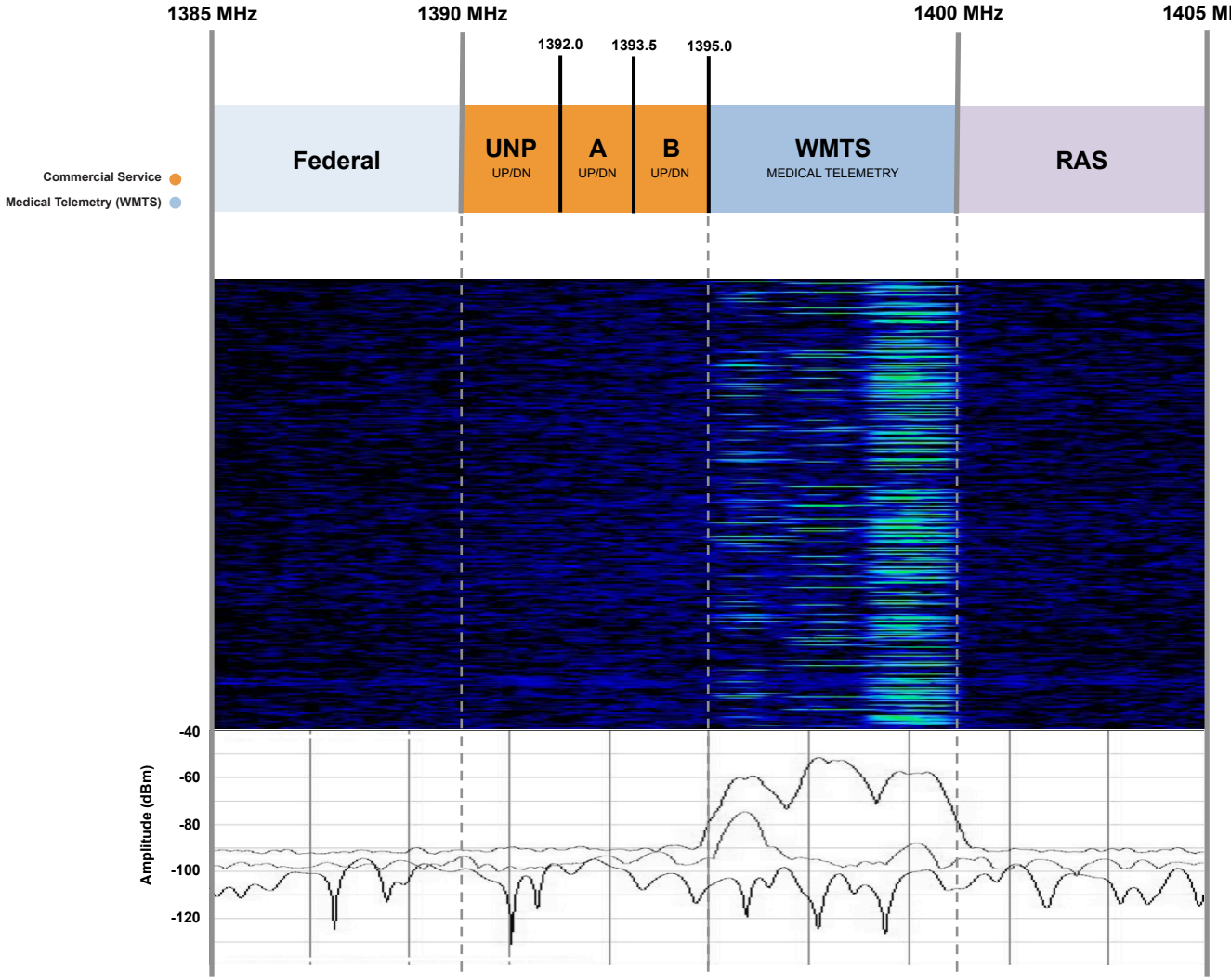


1.6 MHz Channel – Channel 6



Typical 1.4 GHz WMTS Spectrum Conditions – Lower Band

TerreStar measurements of lower band 1.4 GHz WMTS activity at hospitals in May 2014 indicated a weak signal service nearing capacity. Neither WMTS hardware nor network deployments were designed to cope with strong signals from adjacent band commercial services.

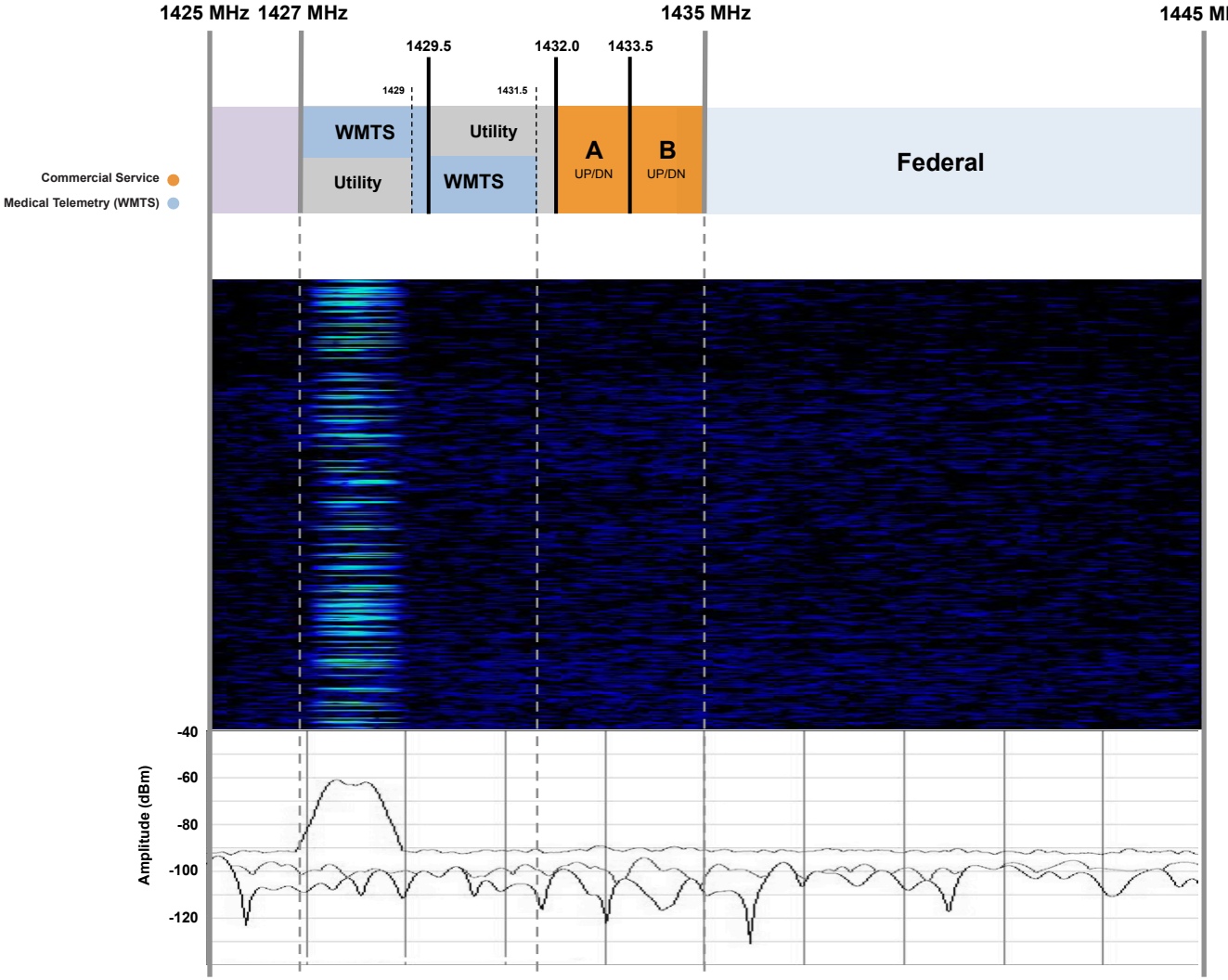


2D SPECTROGRAM

Location (Facility): St. Elizabeth Medical Center
Location (City): Boston, MA
Location (Coordinates):: 42.349022° -71.148236°
Frequency: 1385 - 1405 MHz
Analyzer: RSA 306
Antenna: OmniLOG 70600
Date: 30 May 2014

Typical 1.4 GHz WMTS Spectrum Conditions – Upper Band

TerreStar measurements of upper band 1.4 GHz WMTS activity at hospitals in May 2014 indicated a weak signal service nearing capacity. Neither WMTS hardware nor network deployments were designed to cope with strong signals from adjacent band commercial services.

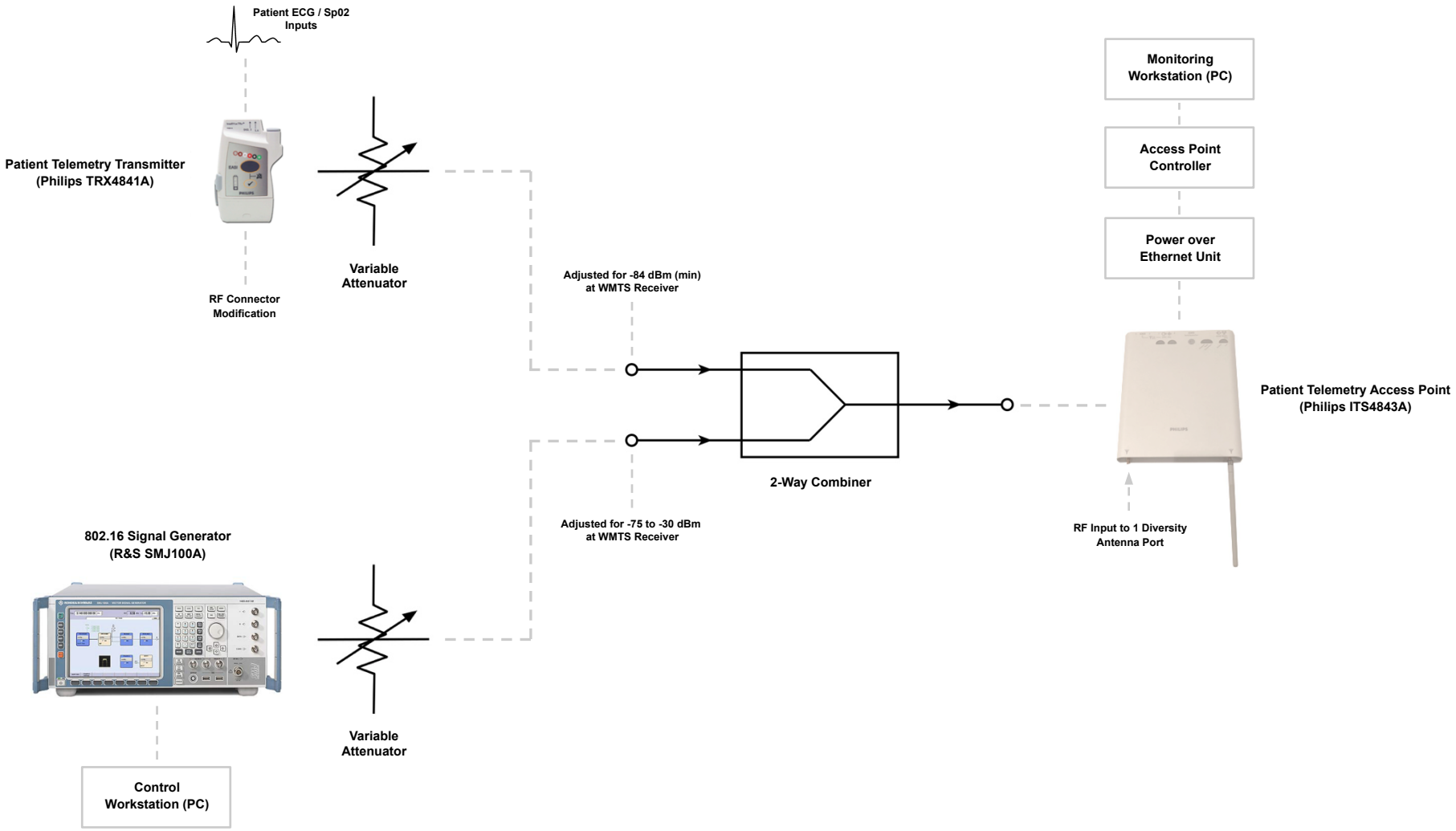


2D SPECTROGRAM

Location (Facility): St. Elizabeth Medical Center
Location (City): Boston, MA
Location (Coordinates):: 42.349022° -71.148236°
Frequency: 1425 - 1445 MHz
Analyzer: RSA 306
Antenna: OmniLOG 70600
Date: 30 May 2014

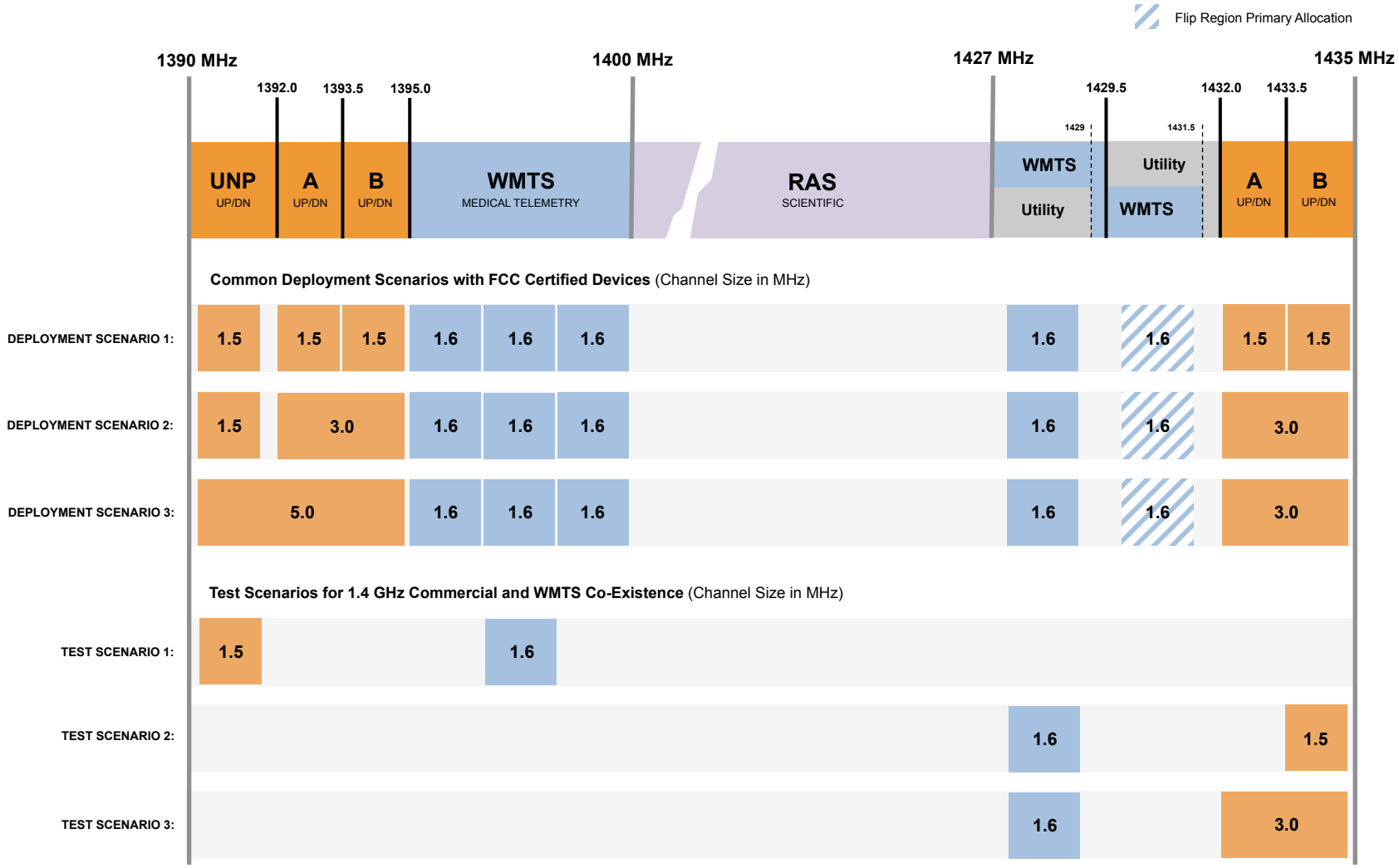
Original 1.4 GHz Commercial to WMTS Conducted Interference Tests

Following serious patient safety warnings from WMTS device manufacturers in 2014, TerreStar began independent tests to verify the interference problem. Conducted tests used commonly deployed Philips WMTS hardware and assumed >3 dB margins on minimum operational sensitivity.



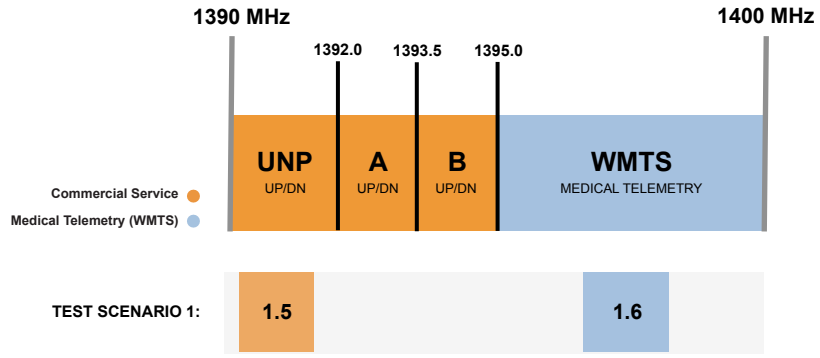
Operational Scenarios Studied in Conducted Interference Tests

While commercial and WMTS device certifications and deployments indicate full utilization of the upper and lower bands, initial testing considered only the impact of single commercial channels on single WMTS channels. Three such scenarios were analyzed.



Summary Results of Original Lower Band Conducted Tests

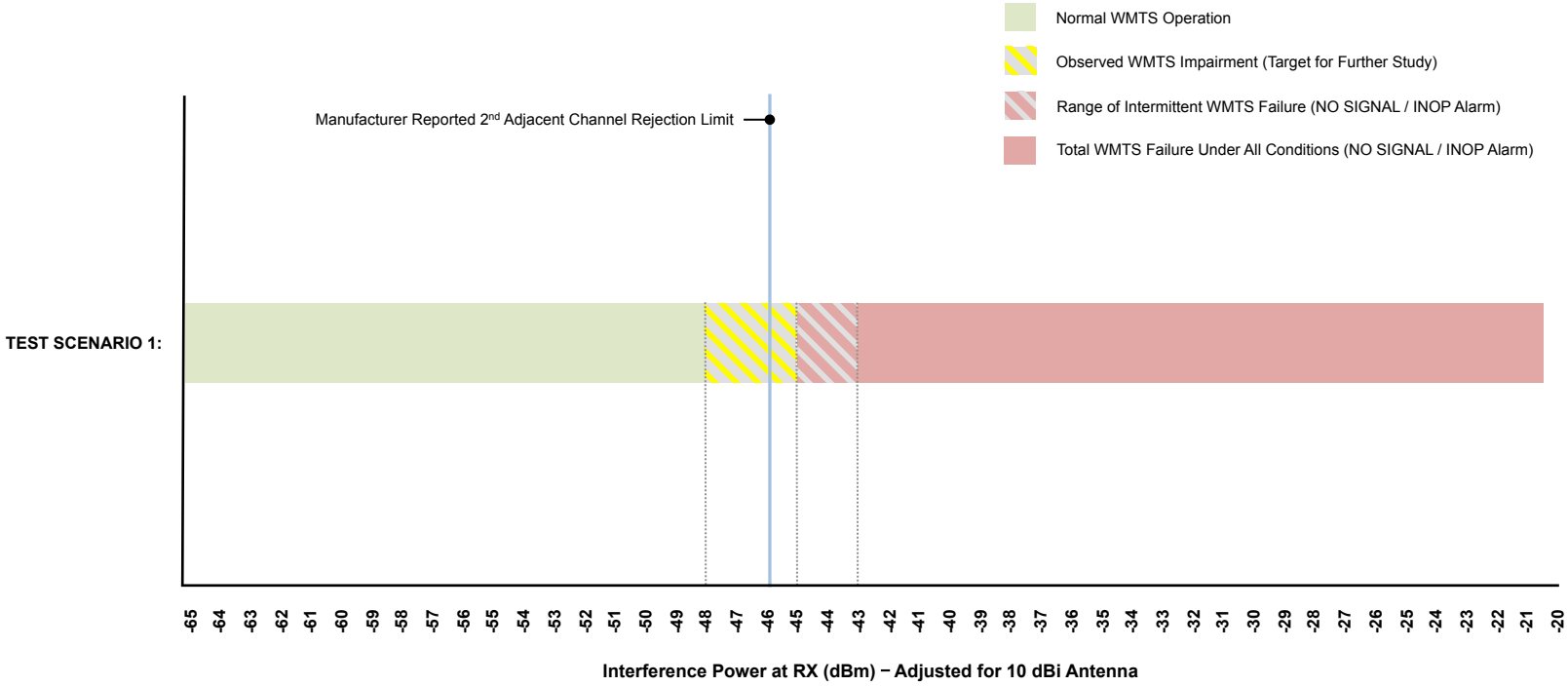
Conducted interference tests of the lower band were designed to indicate the incident power levels where WMTS operation was fully impaired. In Scenario 1, 32 test runs indicated onset of WMTS failure at interference power levels from -45 dBm to -43 dBm.



Lower Band Test Conditions:

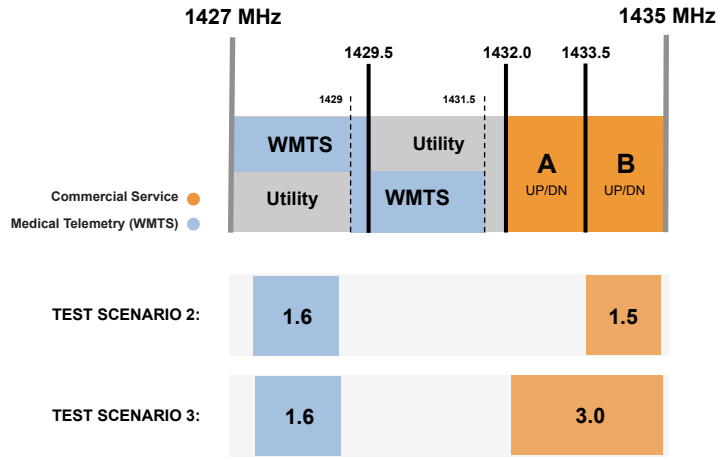
Interference Source: 1.5 MHz 802.16 Emission
Duty Cycle: ~60%
Incident Power at RX: -75 to -30 dBm

WMTS Source: 1.6 MHz DECT Emission (Channel 2)
Duty Cycle: Variable, ECG + Sp02 from single human subject.
Incident Power at RX: -84 dBm (minimum)



Summary Results of Original Upper Band Conducted Tests

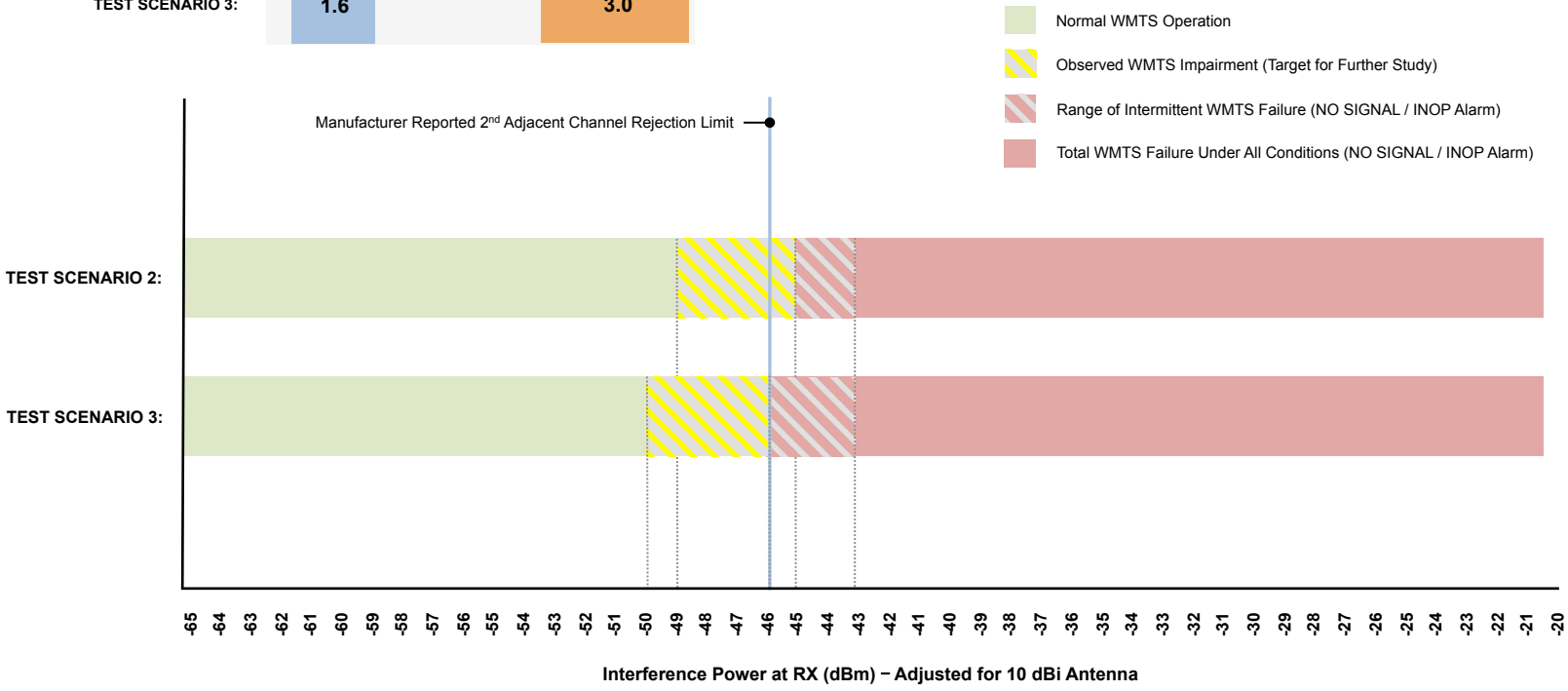
Conducted interference tests of the upper band were designed to indicate the incident power levels where WMTS operation was fully impaired. In Scenarios 2/3, 32 test runs indicated onset of WMTS failure at interference power levels from -46 dBm to -43 dBm.



Upper Band Test Conditions:

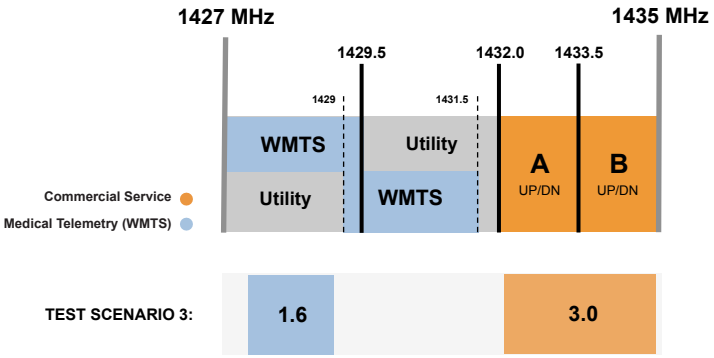
Interference Source: 1.5 MHz / 3.0 MHz 802.16 Emission
Duty Cycle: ~60%
Incident Power at RX: -75 to -30 dBm

WMTS Source: 1.6 MHz DECT Emission (Channel 4)
Duty Cycle: Variable, ECG + Sp02 from single human subject.
Incident Power at RX: -84 dBm (minimum)



LOS WMTS Failure Range for Low Power Device Interference

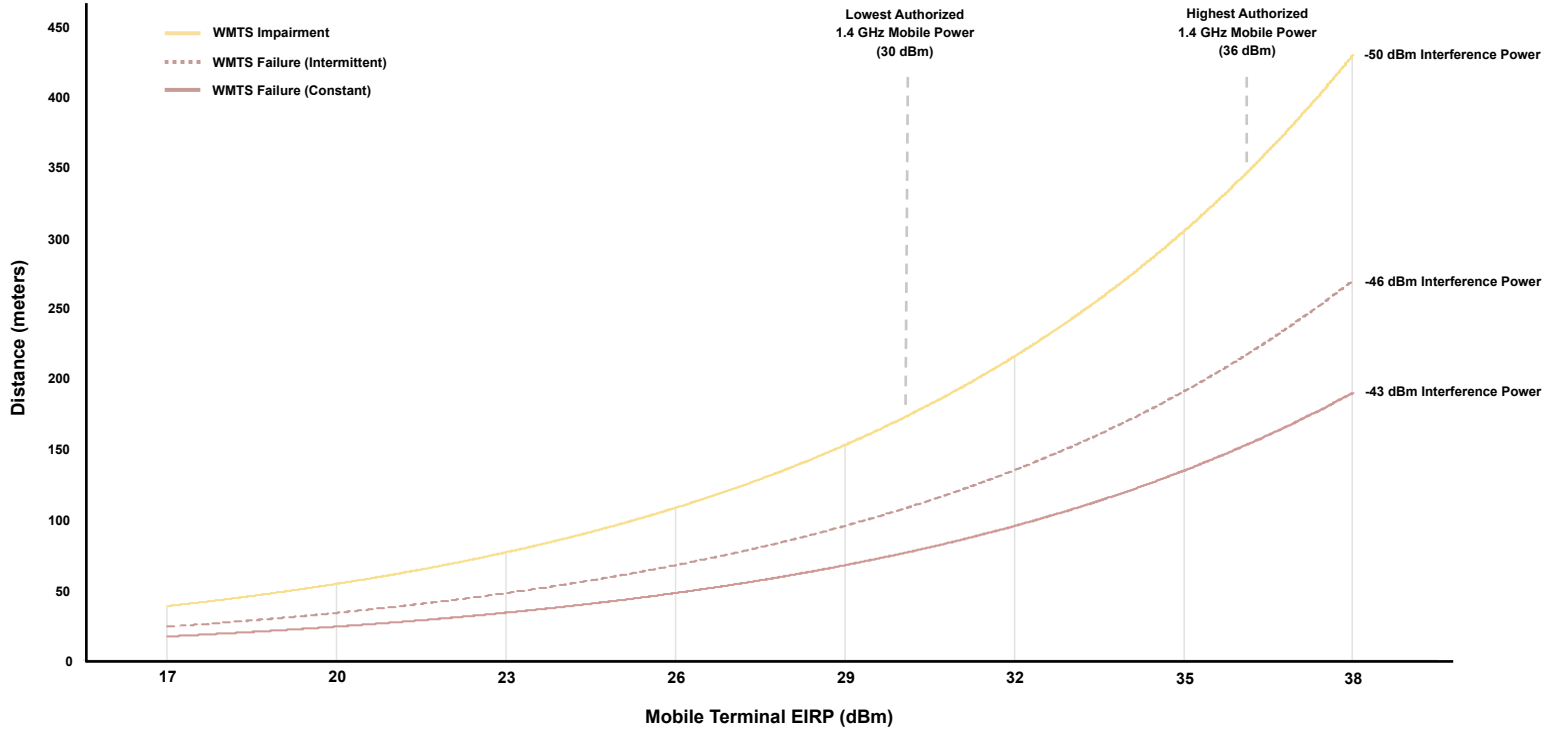
Test Scenario 3 revealed onset of intermittent WMTS failure at interference power levels of -46 dBm. This indicates large LOS interference zones for low power mobile terminals. Duplex operation of the commercial 1.4 GHz band presents significant risk to WMTS.



Upper Band (Scenario 3) Test Conditions:

Interference Source: 3.0 MHz 802.16 Emission
Duty Cycle: ~60%
Incident Power at RX: -75 to -30 dBm

WMTS Source: 1.6 MHz DECT Emission (Channel 4)
Duty Cycle: Variable, ECG + Sp02 from single human subject.
Incident Power at RX: -84 dBm (minimum)



VII: Conclusions of the Initial WMTS Interference Study

Conclusions of the Initial WMTS Interference Study

① WMTS Interference Problem is Confirmed

- WMTS receivers are significantly desensed by fully compliant fundamental emissions in adjacent 1.4 GHz commercial spectrum.
- Relatively low incident power levels (-46 dBm) can cause intermittent failure of WMTS patient telemetry links.
- Widespread deployment of WMTS networks makes probability of patient harm from monitoring disruption extremely high.

② WMTS Interference Problem is Caused by Insufficient Receiver Selectivity

- WMTS networks must operate with extremely low power (<10 mW) patient worn telemetry transmitters.
- Commonly deployed WMTS receivers use Surface Acoustic Wave (SAW) filters with very wide passbands (~64 MHz).
- SAW filters in WMTS receivers apply no attenuation to any part of the adjacent 1.4 GHz commercial allocation.

③ WMTS Interference Problem is Not the Result of Regulatory Non-Compliance

- All currently certified 1.4 GHz Smart Grid and WMTS transceivers are fully compliant with Parts 27 and 95.
- Part 95 rule compliance does not require demonstration of adjacent band rejection by WMTS receivers.
- Relevant standards for medical device interference immunity exempt the commercial 1.4 GHz band.